to remind our friends of another duty, which they too often neglect—the education of his workmen is a duty, which the engineer thinks he has nothing to do with, he pays the man his wages, and there is an end of the matter, the master may go on in neglect, and the workman in vice, and few take the trouble to consider whether it really is of importance to them or no, whether the workman becomes an intelligent being or a besotted brute. Let those however who think so read the evidence of Mr. William Fairbairn, given last year before the Parliamentary Committee on the state of the working classes, and he will see that by following his worthy example that much is to be done that will bring its own reward. The educated workman may not become a more skilled mechanic, but he becomes a better servant, he knows his own interests better and those of his master, he is steadier, less given to combination and to strikes, and in the words of the Quaker cotton spinner, has a positive money superiority. The untaught man, however skilful, is too often the source of annoyance to himself and others, looking with ignorant jealousy on his employers, he is ever watchful against any fancied infringement of his rights, ready on any sudden turn to fall into the snare of combining to increase his wages, and however large these may be too often spending both his money and his time in sensual and debasing gratifications, without making any provision for the time when his strength and his youth no longer avail him. It is this latter circumstance which should direct our attention to do what we can for the improvement of the workman's understanding and his morals, and at the same time we should endeavour to retrieve the errors of the past by giving every assistance for the relief of the unfortunate. Urged by these motives many of the most eminent of the mechanical engineers have come to the determination of forming an institution for effecting the desired results by their own aid, and by the contributions of the workman, so that the operative will at last be enabled to make a provision for himself, his widow or his orphan. The workmen of Messrs. Maudslays have already held a meeting for this purpose. At the late anniversary of the Committee of Marine Engineers, it was proposed that some general measure should be adopted for extending the plan to all parties connected with mechanical engineering. A specific plan has not yet been adopted, but the following among others have given their sanction to the general principle, and have agreed to carry it out—Bryan Donkin, Esq., V.P., Inst. C.E., Messrs. Maudslay, Sons and Field, Messrs. Miller, Ravenhill and Co., Messrs. John Penn and Son, Messrs. John and Samuel Seaward, and Capel, Messrs. Fairbairn, Murray, and Hetherington, Messrs. John and Alfred Blyth, John Hague, Esq., James Simpson, Esq., and W. Simpson, Esq., &c. Under such auspices we trust that the proposed institution will be established, and as immediate steps are to be taken to carry it out, we anticipate soon to witness its beneficial effects. Having given this information to the profession, we shall make no application to them for support, as we are sure that they want no asking to use every exertion for so laudable a purpose. In the course of next month we hope the Society will be organized, and in the meanwhile we shall be happy to be the medium of any communications addressed to it through our office.

ARCHITECTURAL COMPETITION.

Brown v. Langshaw.

Sir—In consequence of the erroneous reports of this case in the Cambridge papers and elsewhere, and particularly the attack upon my professional character contained in a review in the last No. of "The Civil Engineer and Architect's Journal," it has become necessary in self-defence to publish a plain statement of the facts connected with the whole matter. Wrong conclusions ignorantly or designedly drawn from correct statements, may be safely left to the judgment and common sense of the public, but when injurious imputations and charges affecting one's reputation are founded on error or perversion, a man must set but little value on his character were he to suffer them to go forth uncontradicted and unrepelled. Such is my position, and I confess it is one in which I did not expect to be placed, through at least respectable organs, and after the acknowledgment openly made in court by his Lordship and the defendant's counsel, that my character was in no way impeached in the transaction. I will not occupy your valuable space, as I had intended, by specifically replying to the errors and falsehoods contained in the report given in your last month's Journal, but will at once proceed to sketch the principal facts of the case, in order that the public may see its merits and judge whether, instead of my having deceived and misled the committee, I have not been most harshly and unjustly treated throughout the matter, and greatly wronged by the incalculable result of the late action.

I forbear also expressly replying to the imputations and assertions founded upon the mis-statements to which I have alluded, as I consider it sufficient to disprove the premises on which they are based, and rely on that amends which those who have been led to circulate them will, as honourable men, I am sure, award me.

It was in February, 1837, that I received a letter from the Rev. George Langshaw (see letter A,) as chairman of the committee, inviting me to compete with Mr. Rickman, Mr. Poynter, Mr. Sharpe, and Mr. Walter of Cambridge, in furnishing plans for the intended new church there. Taking the cue from this letter, in which the defendant writes "we are anxious to accomplish something as worthy as possible of the example of former days, more especially as our church will stand in the middle of Cambridge, opposite Christ's College," and from his criticism, "I will candidly tell you that your new church at Stamford has pleased many here, though the *inside* has been thought not equal to the outside," I prepared a design in which the interior was rendered exceedingly rich and effective, and the exterior considerably more ornamental than the Stamford church.

The latter structure, built on a design somewhat similar, and so furnishing practical data to a considerable extent for my estimate was executed for £3,500. The amount of expenditure fixed upon for the Cambridge church was £4000 *and* £500 (the value of the materials of the old church), but towards the completion of my drawings I had some misgivings as to the possibility of executing the building for this amount, and upon making my estimate, these misgivings were confirmed.

In laying my drawings before the committee, therefore, I distinctly declined to undertake to carry the design into execution, as it then stood, for the £4,500, but explained that certain portions of the ornamental work could be omitted, without in the slightest degree affecting the integrity or general design of the buildings, so as to bring it within that sum. (See letter B.)*

What other course, let me ask, would any man, even of the most fastidious sense of honour and integrity, have had me pursue? the more especially when it was known that my drawings were not completed even until the day they were sent off to Cambridge.

In October following I received a letter from the defendant, informing me that my plans were preferred, and I shortly afterwards attended a meeting of the committee, and received instructions to make certain alterations in the ground and gallery plans, and to prepare two new perspective drawings of the exterior and interior denuded of the expensive ornamental work, and exhibiting the building in the state described in my letter.

The plans thus altered and those unaltered were then again submitted to the committee, and the whole were formally approved by receiving the defendant's signature.

At the preceding meeting, however, certain conditions had been drawn up by the committee in the shape of resolutions, the effect of which was that they might decline my plans altogether, if the tenders should exceed the amount of £4,500, and that in that event they should not be bound to make me any remuneration for my drawings and trouble, beyond what would be made to the unsuccessful competitors. To these conditions it was required that I should give my unqualified assent before my plans could be finally adopted; but to this I had strong objections, considering them, by their stringency, calculated to embarrass and prejudice me, but proposed to qualify the condition as to the rejection of my plans, by adding the words "if the excess of the tenders should not be sufficiently accounted for."

Whilst this was being debated, the committee instructed me to prepare drawings and estimates of transepts, school-room, crypt, &c., and make many other alterations.

I did so, and at last, upon being pressed for an assent to the conditions, and assured privately by the defendant that these terms were only imposed as a matter of business, and with no intention of taking any undue advantage of me, I was induced at last to give it. My plans were thereupon formally adopted, and I received instructions to prepare the working or contract drawings; this was in December, 1837. Bearing in mind the observations in Mr. Langshaw's first letter before alluded to, and moreover perceiving that on the part of the committee generally there was still an earnest desire to obtain a building of as ornate a character as possible, I was induced, in preparing the working drawings, to assimilate them very nearly to the more ornamental features of the original design, relying upon being able to obtain the consent of the committee to the condition that in case the tenders were in excess, I should then be allowed to reduce the working drawings of such ornamental work as would make them agree with the plans considered as adopted. The parish would thus have the *chance* of getting the church so built for the £4,500. I accordingly proceeded with and completed the working drawings pursuant to this

* We have not received this letter."—Editor.

arrangement, and not, it will be perceived, under the resolutions which embraced only the plans as adopted. I afterwards attended a meeting called for the express purpose of inspecting them, where they were *inspected, explained,* and *sanctioned,* so that there was here a formal assent given to them, and I was allowed to go for tenders upon them. For whose benefit was all this done? For my own it could not be; my commission would not have been increased, whilst it was likely my labour would be.

In November, 1838, four tenders were sent in. I wonder there were so many, considering the committee insisted, against my protest, and compelled me to advertize, that they "did not pledge themselves to accept the lowest tender," and that one of the members officiously informed several of the builders applying to inspect the working drawings, that "they need not tender unless they were prepared to build the church for £4,000," or to that effect. All the tenders were in excess, a probability which the very arrangement I made necessarily contemplated; and what then was the course this honourable committee adopted? Why this (one more notable for its brevity than its equity); the chairman called me before them, and read me a paper stating that the tenders were in excess, and that my plans were declined pursuant to the resolutions. Surprised at this laconic address and summary dismissal, after nearly two years' labour, with more than £200 out of pocket, and in the teeth of a special understanding, I appealed to the agreement, and offered to perform my undertaking; but the only answer vouchsafed me was, "we decline your plans," and this although I afterwards proferred to enter into a bond to find an unexceptionable builder to build the church for the £4,500. Thus I was shamefully shuffled off, and not even afforded the opportunity of making that adjustment between my plans and the tenders, for which I had expressly stipulated (although unfortunately not in *writing*). Had not this arrangement been previously sanctioned, I should not, of course, have ventured the plans for competition, except strictly in accordance with the resolutions.

This is my case, and although the law has enabled my opponents to triumph over me, yet I must contend that equity and justice are still on my side. How far the statements made in the article which has been chiefly instrumental in calling forth this, are consistent with truth, I must leave your readers to decide. I will but remark that my statement flatly contradicts almost every assertion advanced; 1st. that by which I am made to have professed myself "perfectly clear," that my design could be executed for £4,000 or even £4,500, sufficiently disproved by my first letter to the committee. 2ndly, the statements as to the proposed amount of expenditure, which was £4,500 instead of £4,000. 3rdly, the gratuitous assertion that the committee were "troubled with a prejudice," &c., when the fact was, that the "conditions" were imposed subsequently to the competition, and after my design had been preferred and accepted, notwithstanding the contents of the letter accompanying the drawings, by which I so fully explained how the matter stood. 4thly, as to the time I kept the action hanging over the heads of the committee, it was not "nearly *four* years," but only about *two*, and this through unavoidable circumstances. I will not swell a long letter with the detail of my offers to meet the committee, and enter into explanations of any possible misunderstanding, or to refer the matter to some disinterested party for arrangement, made first by myself and then through my attorneys, nor dwell upon the inference to be drawn of the committee's fearing to meet the truth, by their pertinacious refusal either to see or hear me, or listen in the slightest degree to any amicable proposition. It was thus, with the greatest reluctance and compelled by obstinate injustice, that I at last engaged in litigation; I must otherwise have quietly sat down under a gross injury, which neither suited my interest nor comported with my duty. Besides, in going to trial, I had a further object in view beyond gaining a verdict, and that was to bring as much of the merits of the case before the public as I could, in order that even had the jury found against me, the true cause of my dismissal might be clearly known, and the prejudice which that fact has produced be removed. But in this, also, I have been foiled by the judge's intention, who did not look beyond the resolutions, although the main points of all I have here stated were actually given in evidence; his lordship, as well as the defendant's counsel, nevertheless, doing me the justice in stating that my character was in no way impeached, even in their view of the case. My counsel's cross-examination of the defendant's witnesses, and right to comment on the whole case, and extricate it from the mystifications of my opponents, was thus stopt, the jury deprived of the power of giving *their* verdict, and my case prevented from having a trial. The only course left me was, therefore, to elect to be non-suited, reserving to myself the power of enforcing my right in such manner as may be most expedient.

Norwich, May 21.

I am, Sir, your obedient servant,
JOHN BROWN.

LETTER A.

To — Brown, Esq., Architect, Norwich.

St. John's College, Cambridge.
February 22nd, 1837.

SIR—As vicar of the parish of St. Andrew the Great in this town, I am requested to inform you that it is the wish of the committee (appointed to carry into effect the re-building of the parish church) to adopt the method of a limited competition in the choice of an architect, and that the persons fixed upon are yourself, Mr. Rickman, Mr. Poynter, Mr. Sharpe (lately travelling Bachelor in the University), and Mr. Walter of Cambridge. We are anxious to accomplish something as worthy as possible of the example of former days, more especially as our church will stand in the middle of Cambridge, opposite to Christ's College. The sum we have raised is £3,300, we hope to realize £4,000 at least. I will candidly tell you that your new church at Stamford has pleased many here, though the inside has been thought not equal to the outside. Would you give us your opinion as to the probable expence of the like church at Cambridge—the freightage of stone I have heard put at £500 or £600. It is possible that something might be saved in our case by retaining and refacing the first story of the present tower, and the arches inside the church. But I shall be glad to supply you with any further particulars when assured of your readiness to send in a plan. I fear we cannot begin this year.

Your's, &c.,
(Signed) "GEO. LANGSHAW."

IMPROVEMENTS ON ECCENTRIC RODS.

SIR—I happened not to have seen any of your excellent numbers for this year till a few days ago; I see that there are several communications from Mr. Pearce, respecting an improved method of reversing engines with one fixed eccentric, which he has invented. I do not doubt that Mr. Pearce has the merit of making the discovery, but I merely write to state that about 18 months ago, when engaged in a large engineering establishment near Manchester, I made the same discovery, and made a model in wood which acted so as to give the lead with perfect accuracy both ways, and on the same principle, viz., by establishing a *proper proportion* between the length of the eccentric rod and the length of the double arms of the valve rocking-shaft. I am aware that engines have been reversed time out of mind, by means of a double lever on the rocking-shaft for working the valve, particularly coal-pit engines, and at one time Messrs. Sharp and Roberts of Manchester made the reversing gear of their locomotives on a similar plan, but so far as I know, no one has hitherto given the lead correctly both ways, by making the eccentric traverse a certain determinate angle in being shifted from one end of the lever to the other, and it is this which constitutes the merit of Mr. Pearce's invention.

I am, Sir,
Your obedient servant,
D. T.

Portland Street, Glasgow,
30th April, 1841.

PAPER ON HARBOURS AND RIVERS.

On the means of improving the Navigation of the River Lune up to the Port of Lancaster.

BY JOHN ROOKE, ESQ.*

The nautical survey of the river Lune up to the port of Lancaster, by Messrs. Stevenson, is illustrated by facts such as pure science requires in the framing of correct plans. Their report, however, is so brief, that scientific exactness could scarcely be expected, and indeed was not needed. Deepening the channel, on certain lines delineated on the plan of their survey, by the application of the dredging machine, until a specified depth and width of water is obtained, appears to be the main feature of their report.

But with some of their statements (and these concern the objects for which the report is drawn up most intimately) I am at issue; and in support of the objections here taken, all the exactness of details embodied in the survey and plan would seem to be called for. It is fortunate, therefore, that their proceedings have embraced so much exactness of information in detail. From Glasson to Heaton the diminution of fall in the channel of the Lune is about two feet and three-tenths per mile; and from Heaton to Lancaster, one foot and seven-tenths per mile. Messrs. Stevenson state in their report that "the

* This paper originally appeared in the Lancaster Guardian.

great object to be kept in view in carrying into effect the improvement of the navigation of the Lune, is the free admission of the greatest possible quantity of water from the sea." Conformably to this decisive conclusion, "The reporters beg leave particularly to point out the necessity of using much caution in encroaching on the tide-covered banks of the river, and the shutting out large portions of the tide water, and impeding the effect of that powerful, constant, and therefore most efficient of all agents in preserving the depth of navigable channels."

Directly opposed to this imperative conclusion, I should think that reliance ought to be chiefly placed upon the scour which the fresh water and tidal wave combined occasion in a fixed and compressed channel, because their united action and force is concentrated and constant; whereas, in a widely spread estuary, their action is trivial on any given line of channel, liable to change and to obstruct navigation. Hence a perfectly even, a compressed, and a securely fixed channel is that by which the navigation of the Lune may be the most effectually improved; and not by placing reliance on the scour effected by the tide chiefly, as Messrs. Stevenson would appear to intimate.

Agreeably to my view of the effect produced by the combined scour of tidal and fresh water in a compressed channel, is not silt frequently deposited along the quay of Lancaster by the tides in summer, which autumnal and winter floods of fresh water scour off again? This is so far an undeniable fact, and utterly at variance with the absolute theory put forth by Messrs. Stevenson. Let the fresh water stream be altogether withdrawn from the channel of the Lune, and in a very few years that channel might be confidently expected to become superior marsh land. Because the tidal force at its greatest power, according to the elaborate survey of Messrs. Stevenson themselves, during the flux of spring tides in the Lune, exceeds that of the reflux tides more than two fold; and hence more silt is driven upwards by such tides ("the most efficient of all agents in preserving the depth of navigable channels," as Messrs. Stevenson assert,) than the power of their reflux is adequate to carry back to the sea again. In so far all the facts collected by these engineers themselves, are utterly at variance with a theory on tidal agency, they have expressed in the most unqualified terms.

When they reported in such a manner on the navigable channel of the Lune, did they forgot that of the Clyde for fifteen miles below Glasgow? or have they witnessed the channel of the Tyne from Newcastle to Tynemouth? or that of the Avon from Bristol to King's Road? And are they unacquainted with the fact that the channel of the Thames, fixed in a compressed course by the strong ground of Tilbury on the north and Gravesend on the south, is navigable for steam boats, at all times of the tide, for seventy miles from the sea? These undeniable instances of compressed channels of navigation, may well be left to stand in evidence of themselves. Nor can I believe that a navigable funnel so perfectly true throughout, and splendid in outline as the Thames is, can have been otherwise formed than by the unerring science of a day gone by.

What have we on the opposite side of the account? The wide-spread estuary of Morecambe Bay, where there is water enough from the sea, combined with fresh water streams of great power. Then the Duddon claims our notice; and the Ribble also;—not to mention the Lune itself. The wash of Lincolnshire is another instance; and so is the Solway Firth. Now all these navigations are confessedly bad; and unimproveable except by compression. Then they might some of them rival the navigation of the Thames, the Tyne, the Avon, or the Clyde. In Kirkbride Loch, the channel of the Wampool, in five miles from the Solway Firth, loses about 15 feet of fall; it then assumes an exceedingly compressed form, and though but a trivial stream, it then maintains a dead level for three miles inland, along which high spring tides flow. Such a mass of strong evidence needs no comment.

Indeed, with a body of evidence before us so conclusive, why does the channel of the Lune undergo a diminution in depth of water from Heaton to Lancaster at all? The facts collected by Messrs. Stevenson answer this question satisfactorily. For a short distance below the quay of Lancaster the bed of the channel is found to be composed of three feet of hard gravel, resting upon fluviatile clay, or more properly speaking—compressed silt deposited by the flux tides of the sea. It is obvious that the crust of gravel which now forms the bed of the channel, has been brought down the course of the Lune by a succession of floods from the uplands, and deposited on those levels, which the combined reflux of tides and fresh water floods have not had power enough to scour out to sea. Yet on even these unequal terms, the loss of fall from Lancaster to Heaton is about 26 per cent. less per mile than from Heaton to Glasson. Had the tidal scour, therefore, on that portion of the channel where the admission of water from the sea is the greatest, and notwithstanding an accumulation of gravel from the Uplands, been equal to what it is where the tideway is the most compressed, the actual depth of water at Lancaster quay must have been three feet more than it is at present. With a body of facts and incidents so plainly in the possession of Messrs. Stevenson, for what reasons, or on what authority they adopted the theory of—"The free admission of the greatest possible quantity of water from the sea," I shall leave to their candid explanation; and I think myself abundantly justified in tearing away the entire foundation of a theory so fallacious and opposed to the improvement of navigable channels in general.

When all the evidences under which the port of Lancaster may be placed are brought into a distinct sum, the whole matter for consideration is plainly brought before the commissioners of the port, and awaits their decision. Shall the accumulation of gravel from the Uplands be allowed to continue until Lancaster ceases to be a port? Certainly not. The value of the quay and warehouses alone, not to say the prosperity of the town, and the traffic of its railway, demand the most spirited and well considered exertion, though the task left for their execution may be an arduous one.

Foremost in importance is the removal of gravel and silt from the channel of the Lune between the old bridge and Oxcliffe. Under skilful modes of carrying on the work, I should think that it might be accomplished for 6*d.* per cubic yard, as most of it could be stowed away at an easy distance. Dredging, including every expense, as estimated by Messrs. Stevenson, and taking into account penetrating an extended bed of hard gravel, may be fairly taken at 1*s.* 3*d.* per cubic yard. This so far decides in favour of the barrow, the pickaxe, and spade. Suppose then a removal of 240,000 cubic yards, at 6*d.* per yard, this head of expenditure would be 6,000*l.* In addition to this, a portion of dredging would be called for on ground where the working of the machinery was less hazardous and severe than upon hard beds of gravel. Admitting, therefore, that 80,000 cubic yards could be removed by contract at 1*s.* per cubic yard, the charge thereon would be 4,000*l.*; thus giving a total charge of 10,000*l.* In addition to these operations, were every facility given for the reclamation of land by silting it over within the channel of the Lune, 4,000 acres so reclaimed, at a deposition of 10,000 cubic yards per acre, would absorb 40,000,000 cubic yards on the whole, fix a secure channel, and give a depth of water at Lancaster quay surpassing the highest expectations, thus giving an impulse to the commercial activity of the town, and the prosperity of its manufactures.

Akehead, Wigton, Cumberland,
February 6, 1839.

SIR—Yesterday a gentleman placed in my hands Mr. Brooks' work on Rivers, Harbours, &c., and directed my particular attention to his "New Theory of the existence of Bars," among quotations of opinion on this most important subject, there appears one from a letter of mine which appeared some time back in the "Nautical Magazine," and which Mr. Brooks states are "the words of one who has devoted much time to the promulgation of his theory," *i. e.* "that egress sluicing, or scouring water is the sole cause of a bar;" that he is quite correct in this remark, your own columns bear testimony, and the records of parliament will also convey to posterity the fact that I first published to the world this novel thesis, and the equally novel principle of forming Harbours of Refuge with double entrances, without the use of back-water, a principle which is now recommended by the Commissioners in their Report of a Survey of the Harbours on the South East Coast, and for the same object, and in the same words, that I have used in reference to this affair, viz. "to afford to vessels a free ingress and egress, under all circumstances of the wind and weather."

Taking a deep interest in a matter of so much importance to this great naval and nautical nation, and numbering as I do among converts to my *thesis*, some of the most eminent scientific and practical men of the day, I beg you will be pleased to reserve for me in your next number, a space for the insertion of some observations on Mr. Brooks' Theory of Bars, as developed in the pamphlet referred to, in which observations I shall repeat my oft assertion "that bars are the effects of general, and not of partial laws, and that the bar at the entrance of Bow-creek, in the river Thames, results from the same cause as do the bars at the disemboguing of rivers in the Torres Straits, and on every other coast in the world." I state this from observations of more than 20 years made on harbours and bars in various parts of Europe, and in Africa.

I remain, your's, &c.

HENRY BARRETT.

London, May 25, 1841.

REVIEWS.

Treatise on the Improvement of the Navigation of Rivers, with a New Theory of the Cause of the Existence of Bars. By WILLIAM ALEXANDER BROOKS, M. Inst. C.E. London: Weale, 1841.

This work is the result of much reading and much research, deriving its materials not only from the engineering literature of England, but also from the best and latest continental writers. Although the volume is small, the labour and attention which have been bestowed are considerable, and none can peruse it without recognizing the spirit of inquiry which animates the writer. One only remark we have to make, which is, that our author does not seem to have done full justice to the contributers to this Journal, and other English writers, in omitting to mention the names of many of the parties, to whose theories he alludes.

In his introductory chapter Mr. Brooks defines several of the theories, proposed for explaining the formation of bars. First, Major Rennel's, which is that they are caused by the current losing its strength at a certain distance in the sea, and so depositing the substances carried with it.—2. Mr. Delabeche attributes it to the ocean piling up detritus on the shore.—3. Mr. Rooke attributes bars to the strength of the current of the flood tide not running in the same channel with that of the ebb; or to the embouchure of the river not being freely open to the course of the tidal current.—4. Mr. Barrett's theory, as our readers know, is, that they are caused by the conflicting action of effluent currents passing into the ocean at right angles to the shore.—5. Another, and the most favourite theory is an imagined insufficiency of backwater.—6. An opinion entertained abroad is that bars arise from the streams in their approach to the sea spreading in surface and diminishing in depth, so as to deposit the sands.—7. Colonel Emy, an eminent French engineer quoted by our author, attributes these obstacles to the ground waves, or *flots de fond*.—8. We now come to the theory put forward by Mr. Brooks, which we shall let him give in his own words.

An accurate examination of the state of a bar river will exhibit a great irregularity of its surface at low water; in lieu of the river presenting at that period a longitudinal section of a succession of inclined planes, described in the preceding description of rivers free from bars, as becoming more and more gentle in proportion to their proximity to the ocean, it will be often found that the declination or slope of some of the upper reaches is less than those nearer the ocean; and the fall at low water in the lower reaches of the river is always so great, as to produce a striking difference in the vertical rise of tide, even at a short distance from the sea; and attendant upon this defective state of the section presented by the surface of the river at low water, is a great extension of the duration of the ebb, beyond that of the upward current of the flood tide.

The river being in this irregular state, the process by which the bar is formed may be thus described.

During the period of the first quarter flood, the current, in lieu of being able to take its natural upward course, as in rivers where no bar exists, is opposed, or effectually checked, by the effluent backwater; the declination of the stream in the lower division of the river presenting a head which insures a strong downward current, long after the tide would have been able to maintain an upward course, provided the backwater had had a free discharge. At this period the flood tide, by reason of its greater specific gravity, occupies the lower stratum of the tide-way, and like a wedge endeavours to force its course up the channel, which it is unable to effect, but merely elevates the lighter effluent water, the lower strata of which, being checked by the opposition of the tidal water, yields to the latter the sand or other materials, which it was capable of holding in suspension, previously to its encountering the conflicting action of the flood-tide; and where this takes place the bar is formed.

To the theory of Major Rennel (No. 1,) Mr. Brooks objects that it is insufficient because the operations described as producing bars take place in all rivers, even in such as having their waters most abundantly laden with sand or mud, are yet free from bars. On Mr. Delabeche's (No. 2), Mr. Brooks says that the action of the waves cannot be the cause, as bars are found in the most sheltered situations, while other rivers abounding with silt are nevertheless free from deposits in the most furious seas. To Mr. Rooke and Mr. Barrett (Nos. 3 and 4), the objection of our author is that in rivers subject to great variation at their entrance, the bar is always found to exist independently of the direction of the discharge into the sea. The backwater theory (No. 5), is confessedly insufficient, the mightiest rivers of the globe presenting staggering exceptions. To the 6th, it is opposed that in the Mediterranean no current is ever opposed to any stream, and that consequently the repose supposed to take place at the meeting of the currents cannot exist. Further, that in the ocean one of the two currents overcomes the other. Mr. Brooks objects to the ground waves or *flots de fond* acting on sudden elevations of the bed of the sea in the manner assumed by Colonel Emy, opposing to it the received opinion that breakers are formed immediately on any portion of the wave meeting violently the vertical face of the obstruction. In support of this view an appeal is made to the geological formation of the north coast of Yorkshire, where nothing is found to corroborate the Colonel's hypothesis. The case of the Adour quoted by Colonel Emy is well shown by Mr. Brooks to be an influence of local causes.

With regard to rivers being free from bars, Mr. Brooks supports Mr. Rooke's views, giving a good definition that whenever a navigable river approaches to the form of a simple inlet for the reception of the tide so far as regards the longitudinal section, presented by its surface at low water, it will either have no bar, or be but lightly obstructed by one. The same, he observes, may be said of those seaports or pier harbours, which though free from bars in their natural state, are well known to become encumbered by them immediately on the introduction of an artificial scouring power. The views of the previous writers, Mr. Brooks has carried out still further, and we are prepared to concur in much that he says. He remarks that

Resuming the investigation into the state of a river, whose entrance is free from a bar, we shall find that, from its junction with the ocean, a long line of navigable course exists with an extremely gentle fall, or slope of its surface, at low water; the river is in this case in a proper train, its longitudinal section presenting a succession of inclined planes, becoming more and more gentle, as they approach the ocean; and the lower course of the river, from the slightness of its fall, approximates to the condition of a frith, or deep inlet, of the coast, or to that of one of those large natural or artificial harbours, which, being mere tidal receptacles, wherein the influx and efflux take place in equal times, are necessarily free from bars.

The river being in this perfect state, as regards the slope of its surface at low water, a consequent attendant upon the latter will be an equal duration, or nearly so, of the period taken up by the flow of the flood tide, with that of the ebb, in the lower reach of the river; by the term flow being understood, the direct upward course of the current of the flood tide, immediately after the true time of low water.

Our author having propounded his theory, goes on to propose his remedies for the cases in which bars exist. His first remedy is to make the bed of the river of more regular inclination.

By this natural elongation of the course of rivers by the deposit of alluvial matter, a gradual amelioration of the navigation must take place, inasmuch as that elongation is necessarily attended with a more gradual junction with the waters of the sea, or the diminution of the velocity of the current at the point of discharge; we have therefore only to assist the operations of nature by directing the course of the current, and thereby the position of the deposit of the alluvions, to insure that the latter shall act beneficially and not prejudicially to the navigation.

He then goes on to provide for other cases.

In a tidal river, where a bar exists, and the reduction of the declination of the low water surface cannot be effected, by reason of a long length of rocky bed, too costly to remove, the only means available for its improvement is an artificial elongation of its course, by piers or other works, to bring the mouth of the river within the influence of a stronger current.

Where the declination of a river is great in its lower reaches, the result of any cut near the embouchure of the river, which is not attended by a simultaneous reduction of that declination, must be the increase of the bar. It is however to be observed, that the natural attendant effect of the shortening the course of the current, is the more free discharge of the water and abasement of the level of the surface of the current; and wherever this latter circumstance does not take place, it is solely due to the presence of some geological feature, such as rock or marl, which the current, when unassisted by art, is unable to act upon.

Upon the use of artificial scouring power, where used with the view of increasing the effect produced by the natural backwater of rivers, we find it observed.

Assuming, therefore, that the volume of the natural backwater is so small as to be inadequate to maintain a sufficient depth in the harbour for the maritime wants of the port, and that the aid of an artificial scouring power be requisite, still the latter should not be made use of, except during that period of the ebb when its effect is to remove seaward the matter held in suspension by the effluent water.

If, therefore, any portion of the artificial backwater be discharged during still water, or during any period of the flood tide, we may anticipate a rapid deposit, or accumulation on the bar.

In order to secure the utmost useful effect from an artificial scouring power, it is essential that its action be prolonged to a position which is within the range of a strong tidal current, or within the reach of the effect of the prevailing onward impulse by the surf, during on-shore gales.

Where the scouring power terminates *negatively*, if I may use the expression advanced by Major Rennel, or where the effect of the scouring power is unable to extend into a true tidal shore current, it is unreasonable to expect its utmost useful available result.

Thus, supposing the bar produced by a scouring power be situated in a

sheltered situation in a bay, there can remain no hope for its improvement until the place of deposit be removed into the true run of the ebb tide.

With regard to the theory of Mr. Brooks, in our opinion it is as far as that of any of his rivals from being of universal application; in fact we doubt very much whether any such theory will ever be found as one which shall provide for all cases. We must, however, say unhesitatingly, that Mr. Brooks has by developing this theory made an important contribution, not merely to the progress of the investigation, but to the resources of engineering, for this theory will admit of a more general application than any other. We do not like Mr. Brooks condemning all the other theories propounded, for we certainly are of opinion that both the theory and the practice are highly in favour of some of them, as regards their application to such cases as come within their sphere.

The chapter on the causes of the existence of shoals in the beds of rivers, is a highly amusing chapter of controversy on most of the cases which now disturb the engineering world, such as the Clyde, the Wear, the Thames, the Tyne, the Lune, the Dee and the Mersey; the mere mention of which subjects, by the bye, is sufficient to show how much the attention of the profession, and the interests of the public, are engaged in investigations of this nature. The chapter on the causes of the bore, egre, rollers, pororoca, bar or mascaret, is a good contribution to an important investigation; we must, however, call our author's attention to the Solway, and several other English cases which he has not mentioned. Having thus called the attention of our readers to many points, to which we cannot refer at greater length, we must also inform them, that they must not infer from our notice that Mr. Brooks' work is one of theory only, for they will find it of great value on numerous practical points of harbour engineering.

We do not treat Mr. Brooks' work as a complete treatise on the improvement of rivers, and if we did so we should perhaps do him injustice, as he seems principally to have had in view the statement of his own theories, but we cannot leave it without pointing it to our readers as one of the best works on the subject, which has yet been written, and one which they will find calculated to give them much pleasure and much instruction.

On the Subject Matter of Letters Patent for Inventions. By THOMAS WEBSTER, Esq., of Lincoln's Inn, Barrister at Law. London: Crofts and Blenkarn, 1841.

There have been few subjects more debated than that of the operation of the Patent Laws, from which serious difficulties have been felt by all classes of inventors. This has caused a strong demand for Reform in the Patent Laws, an outcry in which we are little disposed to join, as we are more inclined to think that the evils have arisen from the mystifications and misconception of the law, than from any defect in the law itself. No one has exerted himself more than Mr. Webster has done to clear up this subject, particularly in his former work, "the Law and Practice of Letters Patent for Inventions," and he has continued his exertions to the same laudable end in the small volume now before us. Here he shows us what is the subject matter of Letters Patent, supporting the general doctrines by adducing a great number of cases decided. For the sake of simplification he classifies the proper subjects for a patent under three distinct heads.

I. An arrangement, combination, or composition of matter; the particular arrangement, combination, or composition, being the essence and substance of the invention.

II. An arrangement, combination, or composition of matter, with the view of carrying out into practice certain truths, laws, or principles, the particular arrangement, combination, or composition, not being of the essence or substance of the invention, except as in connexion with and subsidiary to the truths, laws, or principles, which are to be so carried out into practice.

III. An application and adaptation of natural or known agents, and of known substances or things.

Mr. Webster next proceeds to describe what constitutes an invention.

The subject-matter of letters patent must possess the incident of novelty, or the principles of the common law and the words of the statute will not be complied with; and further, the result to which it leads must be a new manufacture. But every novelty is not an invention which may be the subject-matter of letters patent; the change must be such as may have resulted from the exercise of or given scope for thought, design, and skilful ingenuity. It is not necessary that either thought, design, skill, or ingenuity, should have been exercised—the invention or discovery may have resulted from guess or accident; and in a great number of cases the whole invention is but the conception of the idea; and whatever may have been the thought or labour before the idea was conceived, or the result attained in practice, yet inasmuch as the result itself gives no evidence of thought or labour, neither may have been exercised. This is peculiarly the case with many of the inventions which are applications of known agents and things, and described above under the third class. In most of these cases the practical application of the idea is easy and simple, and will suggest itself as soon as the idea; in fact, the whole invention is realized as soon as the idea is conceived. In these cases then it is only necessary that the possibility of thought, design, and skilful ingenuity, having been exercised, should not be excluded. The simple substitution of one material for another, as brass for copper, in any construction, may or may not be an invention or discovery which could be the subject-matter of letters patent. Suppose a machine for making iron nails in a particular manner—the application of that machine to making copper nails, there being no adaptation, no change in any part of the manufacture but the substituting of copper for iron, the machine being worked precisely as before, could not be the subject-matter of letters patent. Cases of this kind must be determined by other considerations, as the utility of the change.

This definition Mr. Webster supports by several cases in which the same doctrine has been laid down by the law authorities, and then proceeds in a similar manner to define what is novelty, non-use, and utility in a patent, concluding with a review of practical proceedings.

The various matters treated of in the preceding pages, may be illustrated and confirmed by a review of the practice of obtaining letters patent. The party soliciting the letters patent represents to the crown that he is in possession of an invention, which, as he believes, is new, and will be of great public utility. Thus the conditions of novelty and of utility are at once introduced as material and essential; the failure of either of them would be a ground for avoiding the letters patent, as having been obtained on false suggestion. Upon this representation, and on the consideration that it is entirely at the party's own hazard, whether the invention is new, or will have the desired success, and that it is reasonable for the crown to encourage all arts and inventions which may be for the public good, the law officer of the crown recommends the grant, with a proviso requiring the inventor within a certain time to cause a particular description of the nature of his invention, and in what manner it is to be performed, to be enrolled in the court of Chancery. This proviso gives rise to the specification, upon which instrument so much depends, for if it does not satisfy the terms of this proviso, and, further, is not a full and fair disclosure of all the inventor knows, the letters patent will be void.

We are very glad to find that Mr. Webster's well known scientific attainments have induced him, to turn his attention to the study of so important a branch as that of the Law of Patent Invention, and we have no doubt that he will find himself amply repaid by the results for the labour and talent he has devoted to these researches, while to the patentee it will be a great advantage to find that they have a barrister, who is so well acquainted with every department of the subject, one who unites to the acumen of the barrister, a practical knowledge of mechanics and science.

The Mechanics of Engineering, intended for use in Universities and in Colleges of Engineers. By WILLIAM WHEWELL, B.D., Professor of Moral Philosophy in the University of Cambridge. London: Parker, 1841.

If we wanted any proof of the high estimation in which engineering now stands as a profession, we shall find it in the present work, where a man of Professor Whewell's attainments feels himself called upon to contribute towards its elementary instruction. The motives which have urged him to this work are so laudable, and they are expressed in a manner so well calculated to give sound counsel to the profession, that we think we cannot do better than insert the following extract.

Various circumstances at the present time make it desirable that the subject of engineering should be treated in such a mode that it may be made a satisfactory part of a liberal education. I refer not only to the attempts now so laudably making in various quarters to improve the professional education of engineers, but also to the desire which is more and more felt in the country, that what our students learn of mathematics in their university career should have some meaning in real life. *In the science of mechanics it has especially happened that the mathematical study of the subject has been pursued with very little regard to its practical application. The consequence of this is, not only that our theoretical teaching is of little value in preparing a person for any part of the business of engineering, but also, that it is of little value as intellectual discipline.* For the student has not been taught to seek and to find, in the mechanism which he sees about him, the exemplification of his theoretical principles; and hence he never learns to think steadily upon the subject, and when his days of pupilage are past, ceases to think upon it at all. This could hardly happen if his education made him familiar with principles readily applicable to every machine and every structure which came in his way; for in that case he would be constantly stimulated to understand what he saw; and clear views of mechanical relations would become

part of the habits of his mind. The relations of space once learnt in geometry do not fade away from our thoughts, because throughout our lives we continue familiar with exemplifications of them in geography, astronomy, and other common pursuits. If the common problems of engineering were to form part of our general teaching in mechanics, this science also might become a permanent possession of liberally educated minds. Every roof, frame, bridge, oblique arch, machine, steam-engine, locomotive carriage, might be looked upon as a case to which every well-educated man ought to be able to apply definite and certain principles in order to judge of its structure and working. And this would, I conceive, be an improvement, not only in professional, but in general education.

Motives, expressed in this modest manner, deprive us of any observations on a work in which Mr. Whewell has shown himself anxious to consult his own reputation and the wants of the public. There are too many who think that a mathematician or a calculator is an engineer, and are too ready to despise practical attainments in the pursuit of abstract studies, so that we feel much indebted to Mr. Whewell, himself a mathematician, for giving so necessary a caution to those who might be led away by the study of a book so delightful as his, into realms so remote from engineering. Mathematics and engineering are roads which for a certain distance are mutual, but we feel obliged to give a hint that there is a point of divergence when the wayfarer has the choice of two separate and far distant paths.

Plans for the Formation of Harbours of Refuge, Improvement of Rivers, and Suggestions for Ameliorating the Condition of Seamen, Preventing Shipwreck, and Miscellaneous Matter. Illustrated with Plates and Charts. By CAPT. J. N. TAYLOR, R.N., C.B. Plymouth, 1840.

Capt. Taylor's plan for the formation of harbours of refuge is by the use of a floating breakwater, this he proposes to secure by moorings of logs of timber shackled together, so as to avoid the inconvenience of chain moorings. The work before us is more accurately described by the title prefixed to the first page, Series of Papers, &c., being a collection of memoranda on naval engineering, and naval officers generally. It includes descriptions of several of Captain Taylor's inventions.

GAS LIGHTING.

1. *A Practical Treatise on Gas Lighting, with Twenty-two Plates.* By THOMAS S. PECKSTON, R.N., C.E. London: Hebert, 1841. (Third Edition).

2. *A Practical Treatise on the Manufacture and Distribution of Coal Gas, illustrated by Engravings from Working Drawings.* By SAMUEL CLEGG, jun., C.E. London: John Weale, 1841.

We have no doubt that our readers who look at these works will do as we have done, pair them together. The names of Clegg and Peckston are extensively known as connected with the subject of gas lighting, so that works emanating from either of them must be hailed by the student and professional man as useful additions to the engineering library. "Arcades ambo" as they are it is difficult for us to decide upon their claims, so that we must earnestly recommend to our readers to purchase both works, and see if they can more readily bring the matter to an issue. Mr. Peckston has long written on gas lighting, and Clegg has been intimately connected with the improvement of the system almost from its very invention, having been one of the first to carry it out on a large scale—what he has done since all the world knows. The work of Mr. Peckston is in its third edition, a circumstance which renders it unnecessary for us to urge claims on which the public has already pronounced, and which will excuse us for any apparent neglect in devoting more of our attention upon this occasion to the first effort of the younger candidate. To say that the profession have looked forward to young Mr. Clegg's work with interest, is to say no more than the bare truth, for the list of subscribers shows the names of all the first gas engineers in the country, who thus have already expressed their confidence as to his competency for the task he has assumed. They could not well doubt this, for he comes to the subject armed not only with his own knowledge and experience, but with those of his father, to whose valuable memoranda he has had ready access.

The distribution of both works is much the same, the introductory chapters giving a short history of the progress of the art, a sketch of chemistry as applied to this manufacture, and an account of coal. From the statements of Mr. Peckston and Mr. Clegg, it appears that the late talented Mr. Murdoch was the first person who introduced gas lighting for practical purposes. He first lighted his own house at Redruth, in Cornwall, in 1792; afterwards in 1798 he erected an apparatus for a similar purpose at the manufactory of Messrs. Boulton and Watt, at Soho—a pleasing reflection to find that the great improvers of the steam engine should also be the first to patronize the introduction of lighting by gas against all the prejudices and superstitious feeling of the day—the next place lighted, by Mr. Murdoch, upon a large scale, was a cotton manufactory at Manchester in the year 1805, the apparatus for which was made at the works of Messrs. Boulton and Watt. A paper by Mr. Murdoch describing the apparatus was read before the Royal Society, February 25, 1805, from which paper we collect that the number of burners employed in the manufactory amounted to 271 argands and 633 cockspurs, each of the former giving a light equal to four candles, and the latter a light equal to 2¼. It appears, that at the same time Mr. Murdoch was engaged in fitting up the gas apparatus at the above manufactory, that Mr. Clegg (the father of the author), was engaged in a similar manner for lighting a cotton mill near Halifax, which Mr. Clegg states was lighted a fortnight before the cotton mill at Manchester, a circumstance however which does not militate against the claims of Mr. Murdoch as being the first who introduced gas lighting for practical purposes. The next place lighted was the Catholic College at Stonyhurst, Lancashire, (in 1807, 1808), when Mr. Clegg had an opportunity of making several experiments for purifying the gas, using for that purpose lime water in a separate vessel, which was to render the gas pure. We now come to the time when gas was attempted to be introduced upon a large scale for lighting the public streets, when we find ourselves indebted to Mr. Winsor for his indefatigable zeal, in exerting himself (even as early as 1803-4,) by lecturing and other means, to overcome the prejudices of the public; through his exertions a company was formed in 1809, called "The London and Westminster Chartered Gas Light and Coke Company," in that year application was made to Parliament for incorporating the company, but from the obstinacy and prejudices of several parties, as is too frequently the case in new undertakings, the Bill was opposed, and it was not until 1810 that an Act was obtained. During this time Pall Mall was lighted up, but so far from prejudices being allayed, the project was treated with derision by many of the scientific men of that day. Mr. Clegg next proceeds to detail the difficulties the Company had to overcome in the erection of their works, and introducing the gas for public purposes, and it was not until 31st December, 1813, that the Company were able to light any public place, when they lighted Westminster Bridge. Thus we see that a period of 21 years was lost from the date of the first introduction by Mr. Murdoch, before gas was generally adopted.

The early part of Mr. Clegg's volume is occupied with a dissertation on "Chemistry as applied to the Manufacture of Coal Gas," followed by a chapter on "Coal," which affords much valuable information.

The kinds, or rather the different names, of coal used at the London Gas-works are, South Pelaw, Ellison's Main, Felling Main, or East Garesfield Main, Dean's Primrose and Pearith's Wall's-end. Most of the Companies have the facilities of water-carriage, and purchase their coals at the pit for about 7*s.* 6*d.* per ton, and charter a vessel from 8*s.* to 11*s.* per ton, according to the time of the year. If the gas-works are far from the water-side, and they purchase their coals at the market, the above would fetch from 17*s.* 6*d.* to 18*s.* 6*d.* per ton; and to a large consumer, for cash, 5*s.* would be charged for cartage, making a total of 22*s.* 6*d.* to 23*s.* 6*d.* If the gas-works are at the water side, the charges would be as follows:—

	s.	*d.*
Cost of coal at the pit mouth, say	7	6
Freight and loading	8	0
Lighterage from ship to wharf	0	10
Gang of men carrying from barge to works, per ton, according to distance	1	0
Duty 1*s.* 1*d.*, and weighing 1½*d.*	1	2½
	18	6½

At Birmingham and in the neighbourhood the price for Staffordshire coal is about 8*s.* 6*d.* per ton, including all expences.

In Scotland the prices, per ton, paid for the different kinds of Parrot coal at the places where they are shipped, are as follows:—

	s.	*d.*		*s.*	*d.*
Lesmahajo . .	17	0	Marquis of Lothian	17	6
Monkland . .	16	0	Capledsea . .	14	0
Torry Burn .	12	0	Halbeath . .	12	0
Wemyss . .	13	6	Lochgelly . .	10	0

The price of coke in London varies according to the demand; to retailers who fetch the coke it is now about 16*s.* per chaldron, to private persons 18*s.*, and if delivered, from 21*s.* according to the distance. At West Bromwich coke is considered on an average to be worth 4*d.* per bushel.

Under the head of "Advantages of Gas," Mr. Clegg has afforded us some sound practical observations and calculations, which cannot

fail to be highly appreciated by the engineer; the following calculation of the cost, outlay and income of a small gas work is useful, as it shows at what a comparatively trifling expense villages might be lighted.

"If the number of lamps required is known, the materials necessary for the production of the gas to supply those lamps are known also. The profit and loss of such establishments in actual operation may as surely be relied upon as that given upon paper.

Upon a well-regulated system the cost of producing every 1000 cubic feet of gas with the same coal will not vary one penny the whole year round; the quantity of gas made will be adequate to the demand, and no more. The wear and tear of the machinery will be exactly that which was anticipated, and therefore the annual outlay will be known; the sale of the products of the establishment may be depended upon with equal certainty, and the income known; the profit arising from the difference is thus ascertained. I will give as an example the results of a small gas establishment erected in the country.

Apparatus for the supply of 70 public and 75 private lamps cost	£	s.	d.
Retort-house and chimney	500	0	0
400 yards of 4-inch pipe	130	0	0
740 do. 3-inch do.	101	13	4
266 do. do.	129	0	0
	39	13	0
	£900	6	4

Outlay in	1838			1839.		
Coal carbonized	204	17	11	204	19	2
Do. as fuel	54	15	0	54	14	0
240 bushels of lime	6	0	0	6	0	0
One man by day and one by night	62	8	0	62	8	0
Carried forward	£328	0	11	£328	1	2
Brought forward	328	0	11	328	1	2
Lamplighter	31	0	0	31	0	0
Repairs in the streets	15	0	0	16	3	0
Repairs in the works, including wear and tear of retorts, meter and clock	60	0	0	58	16	0
Rent of ground	20	0	0	20	0	0
Taxes	20	0	0	20	0	0
Office expenses	10	0	0	10	0	0
	£484	0	11	£484	0	2

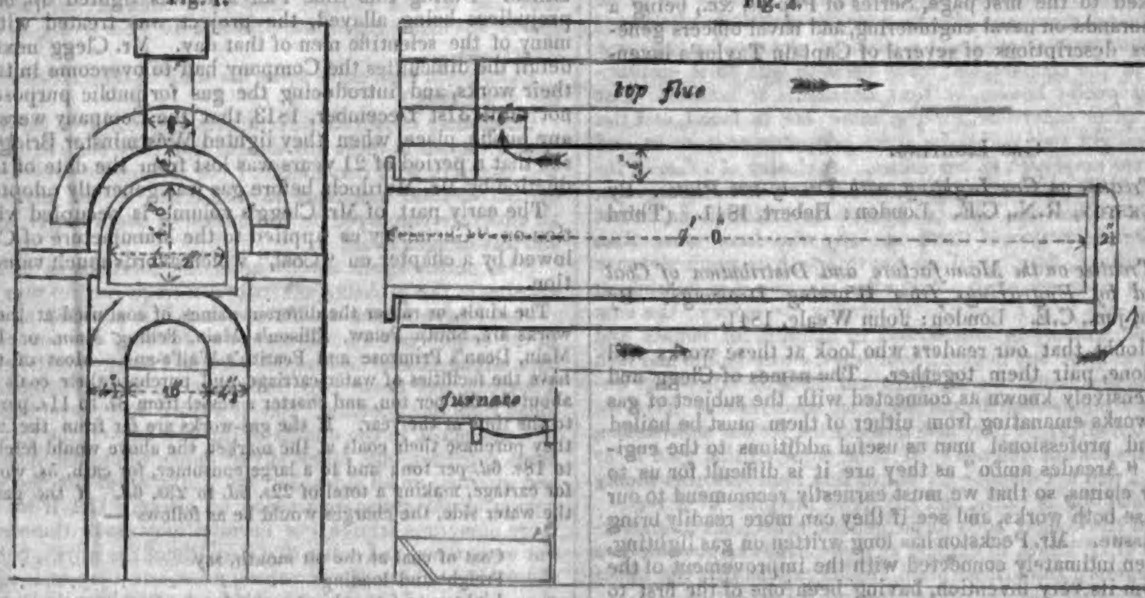
Income in 1838				1839.			
72 private lamps at 3*l.* =	216	0	0	75 at 3*l.* =	225	0	0
64 public do. at 4*l.* =	256	0	0	64 at 4*l.* =	256	0	0
200 gallons of tar at 1*d.* =	0	16	8				
Coke, 247 chaldrons, at 16*s.* =	197	12	0	243 at 16*s.* =	194	8	0
	£670	8	8		£675	8	0
Leaving a Profit of	£186	7	9		£191	7	10

The equal results of these two years is not peculiar to this establishment; there are many of much greater extent that can compare with it."

The chapter on "Retorts," describes the different plans that have been adopted, their faults and advantages, their mode of setting, construction and cost, and is illustrated with some beautiful engravings and wood cuts. The annexed engraving shows the construction of a retort, and the manner in which it is set, when a small quantity of gas is required.

"In country towns, where the quantity of gas made during the winter seasons does not exceed 10,000 cubic feet in twenty-four hours, the retorts must be set singly, as represented in Figs. 1 & 2., the flue passing beneath and over the retort, which rests upon a half-brick arch, cut flat at the top to receive it; the end is guarded by a thick fire-tile."

Fig. 1. Fig. 2.



"Mr. Croll, the superintendent of the Chartered Gas Company's works, (Brick Lane station), has introduced a system of using the coke as fuel while red-hot. The charge from the retorts is drawn into a wrought-iron carriage, and immediately taken to those furnaces which require feeding. He informs me, that the saving effected by this simple process is equal to 10 or 12 per cent.; I should conceive it to be fully that. The reason is evident; because when a quantity of black coke is thrown on the previously heated mass of fuel, the flues will to a certain extent become cool, since the heated air is absorbed. When hot coke is thrown on, no absorption takes place, and the flues are kept up at a uniform temperature."

Mr. Clegg speaks very highly of Mr. Grafton's fire clay retort.

"In England and Scotland the fire-clay retort has superseded the use of metal in no less than forty towns; in some instances it has lasted for the extraordinary period of twelve years; while, during this time, at all other works where the invention is not yet used, it may be asserted that iron retorts have been renewed as many times. The oven or D-shaped retorts are found to be the most advantageous, being made with a capacity to carbonize one cwt. of coal every hour. They can be constructed either to be heated by coke ovens, or coke furnaces, or by the burning of tar: with coke ovens they are more durable. It appears that clay retorts, when constructed upon such a scale as that given in the plate, have great power to *retain* their heat when brought to the proper temperature for decomposing the coal, viz. 27° of Wedgewood.

This power of retaining heat is proved by constant practice to produce 1000 cubic feet of gas per ton from the same coal more than the average of the London produce, and the consumption of fuel is not more than 22 or 23 lb. of coke to carbonize 100 lb. of Newcastle coal, taking the average of six months' working; it is even less with the Staffordshire or Lancashire coal."

We have now shown by our extracts the value of this excellent work, and in the next number we shall proceed to notice the remaining part of Mr. Clegg's book; in the mean time we hope that both the volumes will be in the hands of all those who are desirous of obtaining information on the subject of gas works.

Before we close the present notice, we must offer a just tribute of praise to Mr. Gladwin the engraver, for the very clear manner in which he has executed the plates in Mr. Clegg's work, which are so beautifully delineated, that they cannot fail to convey, even to the non-professional observer, an accurate knowledge of the construction of the apparatus which they delineate.

XENOPHON ON THE ATHENIAN MINES.

Extracted from the Translation by Walter Moyle, Esq., of the Pamphlet on the Improvement of the Revenue of Athens.

Our silver mines alone, if rightly managed, besides all the other branches of our revenue, would be an inestimable treasure to the public. But for the benefit of those who are unskilled in inquiries of this nature, I design to premise some general considerations upon the true state and value of our silver mines, that the public, upon a right information, may proceed to the taking of such measures and counsel as may improve them to the best advantage.

No one ever pretended from tradition, or the earliest accounts of time, to determine when the mines were first begun to be wrought, which is a proof of their antiquity; and yet, ancient as they are, the heaps of rubbish which have been dug out of them and lie above ground, bear no proportion to the vast quantities which still remain below, nor does there appear any sensible decay or diminution in our mines; but as we dig on, we still discover fresh veins of silver ore in all parts, and when we had most labourers at work in the mines, we found that we had still business for more hands than were employed.

Nor do I find that the adventurers in the mines retrench the numbers of their workmen, but purchase as many new slaves as they can get; for their gains are greater or less, in proportion to the number of hands they employ. And this is the only profession I know of where the undertakers are never envied, be their stock or profits ever so extraordinary, because their gains never interfere with those of their fellow traders.

Every husbandman knows how many yoke of oxen and servants are necessary to cultivate his farm, and if he employs more than he has occasion for, reckons himself a loser; but no dealer in the silver mines ever thought he had hands enough to set to work.

For there is this difference between this and all other professions; that whereas in other callings, for instance, braziers and blacksmiths, when their trades are overstocked, they are undone, because the price of their commodities is lowered of course, by the multitude of sellers; and likewise a good year of corn, and a plentiful vintage, for the same reason do hurt to the farmers, and force them to quit their employment, and set up public houses, or turn merchants or bankers. But here the case is quite otherwise, for the more ore is found, and the more silver is wrought and made, the more adventurers come in, and the more hands are employed in our mines. A master of a family indeed, when he is well provided with furniture and household goods, buys no more, but no man was ever so overstocked with silver, as not to desire a farther increase; if there are any who have more than their occasions require, they hoard up the rest with as much pleasure as if they actually made use of it. And when a nation is in flourishing circumstances no one is at a loss how to employ his money; the men lay it out in fine armour, in horses, and in magnificent houses and buildings; women lay it out in great equipages, costly habits and rich clothes. And in accidents of war, when our lands lie fallow and uncultivated, or in a public dearth and scarcity, what reserve have we left to apply to but silver, to purchase necessaries for our subsistence, or hire auxiliaries for our defence? If it be objected that gold is as useful as silver, I will not dispute it; but of this I am sure that plenty of gold always lowered its value, and advanced the price of silver.

I have insisted the longer upon these general reflections to encourage adventurers of all kinds, to employ as many hands as possible in a trade so advantageous, from these plain considerations that the mines can never be exhausted, nor can silver ever lose its value.

That the public has known this long before is evident from our laws, which allow foreigners to work our mines upon the same terms* and conditions as our own citizens enjoy.

But to draw this discourse more immediately to the subject of my present consideration, which is the maintenance of our citizens, I will begin to propose those ways and means by which the silver mines may be improved to the highest benefit and advantage to the public. Nor do I set up for the vanity of being admired for an author of new discoveries; for that part of my following discourse, which relates to the examples of the present age, lies obvious to all the world; as for what is past it is matter of fact, and every man who would be at the pains of inquiring might inform himself.

It is very strange that after so many precedents of private citizens of Athens, who have made their fortunes by the mines, the public should never think of following their example; for we who have heard that Nicias, the son of Niceratus, had a thousand slaves employed in the mines, whom he let out to Sosias the Thracian, upon condition to receive an obolus a day, clear of all charges for every head, and that the same complement of workmen should be always kept on foot. In like manner Hipponicus had six hundred slaves let out at the same rate, which yielded him a revenue of a mina a day, and Philemonides three hundred, who brought him in half a mina a day, and many others made the same advantage, in proportion to the number of slaves they possessed. But what need have we to appeal to precedents of an older date, when at this day we have so many instances before our eyes of the same nature?

In the proposals which I offer, there is only one thing new, namely, that as private men have a constant revenue coming in from the slaves whom they let out to work in the mines; so the public, in imitation of their example, should purchase as many slaves to be employed in the same manner, as will treble the number of their own citizens.

(Xenophon then goes to argue on the advantages of this plan.)

To demonstrate that the mines would take up a greater proportion of slaves to work them, I appeal to the authority of all the living witnesses who remember, what numbers of workmen were employed in them before the taking of Decelea† by the Lacedemonians. And our silver mines that have been wrought for so many ages, with such numbers of hands, and continue still so far from being drained or exhausted, that we can discover no visible difference in their present state from the accounts our ancestors have delivered down to us, are undeniable proofs of my assertion. And their present condition is a good argument that there never can be more hands at work in the mines than there is employment for; for we dig on still without finding any bottom or end of our mines, or decay of our silver ore. And at this day we may open new mines as well as in former ages, and no one can determine whether the new mines may not prove richer than the old ones. If any one demands why our miners are not so forward in pursuit of new discoveries, as formerly; I answer, it is not long since that the mines have begun to be wrought afresh, and the present adventurers are not rich enough to run the risk of such an undertaking. For if they discover a rich mine, their fortunes are made; but if they fail, they lose all the charges they have been at; and this consideration chiefly has discouraged the adventurers from trying an experiment so dangerous.

(Xenophon here urges upon the state to take measures for discovering new mines.)

Companies of private adventurers may carry on the same trade in a jointstock, nor is there any danger that they and the national company will interfere with one another; but as confederates are strengthened by their mutual assistance to each other, so the more adventurers of all kinds are employed in the mines, so much larger will be the gains and advantages to all.

(Our author again dwells upon the advantages of his plan, and in allusion to the probable effects of a foreign war he says)

And I have reason to believe that it is possible to work our mines in the conjuncture of a foreign war, for they are covered on the south by a strong citadel in Anaphlystus, and on the north sea by another in Thoricus, and these two fortresses lie at the distance of but 60 furlongs from one another. But if a third fort were built upon the top of a mountain, in the middle of the two former, the three works would meet together, and other silver mines would be inclosed in a circle, and guarded on all sides, and the workmen at the first notice of an invasion might retire to a place of safety. But if we are invaded by more numerous armies, our enemies may make themselves masters of our corn, wine, and cattle that lie without the works, but if they possess themselves of our silver mines, what can they find to carry off more than a heap of stones and rubbish? But how is it possible for our enemies to make an inroad upon our mines? for the city of Megara, which lies nearest is above 500 furlongs from them; and Thebes which is nearer them than any but Megara, is more than 600 furlongs distant from them.

(We here again omit what Xenophon says about the advantages of his plan.)

The revenue arising from our slaves would not only make a considerable article in the charge of maintaining our citizens, but by the vast concourse of people from all parts, the customs of the fairs and markets at the mines, and the rent of our public buildings and melting houses, and many other heads, would produce a mighty income to the state. The state, upon such an establishment, would be peopled with a prodigious number of inhabitants, and the value of lands at the mines would be as high as those that lie near Athens.

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* This was a tribute of a twenty-fourth part of the silver found, according to Suidas.

† When 20,000 Athenian slaves deserted.

ON BURNING GAS FOR HEAT OR ILLUMINATION.

By SIR JOHN ROBISON, K.H., Sec. R.S.E., M.S.A.

The two following papers were read, March 1839, before the Society of Arts for Scotland.

ON THE BEST MEANS OF BURNING GAS FOR SUPPLYING HEAT.

"Vix ea nostra voco."

When carburetted hydrogen gas is employed in producing heat, it is seldom required that it should, at the same time, give out light; the combustion may, therefore, be managed in any way which may be convenient without seeking to preserve the illuminating power. It appears to have occurred about the same period to the late Dr. Duncan and to myself, that, by passing a current of gas, mixed with atmospheric air, through a wide vertical tube, having its upper end covered by a diaphragm of wire gauze, and by kindling the mixture as it escaped through the interstices of the wire cloth, a convenient stove might be formed for culinary purposes. Dr. Duncan applied some small apparatus on this principle to pharmaceutical operations in his class-room, and I had my kitchen furnished with a range of large stoves, which were intended to supersede the use of French charcoal stoves in various culinary processes. In both cases the success has been perfect, and the same principle has since been adopted with advantage in a variety of processes in the useful arts, where this neat and cleanly method of applying heat has rendered it a valuable acquisition to the work-shop.

The form of the apparatus may be varied in any way to suit the particular process to which it is to be applied; as all that is essential is, that a current of the mixed gas and air shall rise through wire-cloth, and that the proportion of gas to atmospheric air shall never be so great as to allow of the flame becoming yellow, as, with this precaution, the combustion of the carburetted hydrogen will be complete, and no deposit of soot will take place on cold bodies when set over the flames; the proper quantity of gas in the mixture is easily determined by the stop-cock belonging to each stove.

For ordinary culinary purposes, the cylinders may be thirty inches long, and three to four inches diameter, and the wire-cloth for the tops should have about thirty wires to the inch. That which is manufactured for safety-lamps answers well for this purpose.

Whenever, from accidental injury or decay, a hole takes place in a diaphragm, it is no longer possible to use it; as, when lighted, the flame passes through the fracture, and communicates with the jet at the bottom of the cylinder, which then burns like an ordinary gas-light, and, like it, would blacken the surface of any cold body presented to it. The wire-cloths, if not broken through by violence, will last for months although in daily use; and, if covered by a layer of coarse sand or pounded limestone, will continue serviceable for an unlimited period.

When more intense heat is required than is attainable by the unaided combustion of the mixed gases, recourse may be had to various forms of blow-pipes; and when a large volume of such flame is to be employed, the current of atmospheric air may be urged by double bellows. A very efficient apparatus on this principle is to be seen in the laboratory of Dr. D. B. Reid.

It is to be regretted, that such applications of gas are not more generally known and introduced into work-shops, as there are numerous processes in the arts in which they would afford facilities to the workman which he can scarcely command by any other means. For example, in the hardening of steel tools, it is well known that a piece of bright steel, when heated to redness in a forge or muffle, is subject to oxidation, and that a black scale remains after hardening, which it is difficult to remove without some injury to the work, as in the case of a screw tap; whereas, if the same piece of steel be heated in a flame of the mixed gases, where there is no free oxygen to attack its surface, it may be *made and kept* red hot without any injury to its finest edge; it will be discoloured, but without losing much of its polish. The artist has also the advantage of a distinct view of the article while it is being heated, and the power of withdrawing it from the flame the moment it has acquired the proper colour, which, in the hardening of cast steel cutting tools, is of great importance.

Many attempts have been made to apply carburetted hydrogen and pure hydrogen gases to the purposes of warming buildings, and various forms of stoves have been proposed, on the understanding, it would appear, that, by applying the flame of the gas to metallic bodies, an increased degree of heat would be communicated by them to the atmosphere around. A little consideration will show, that however the *distribution* of heat may be modified by such contrivances, there can be no increase of the heating power; and that when a certain measure of gas is fairly burned, the heat evolved into the apartment will be the same whether the flame be disposed as a light, or made to play against metallic plates or other combinations of apparatus. In all cases where the products of the combustion are allowed to mix with the atmosphere of the apartment, without provision being made for carrying them off by ventilation, the effects of such processes must be more or less deleterious to health, according to the proportion these products bear to the mass of air they mix in. On the whole, it may be assumed, that this mode of heating apartments is the most expensive, the least efficient, and, excepting that by Joyce's charcoal stove, the most insalubrious that can be resorted to.

ON THE BEST METHOD OF BURNING GAS FOR THE PURPOSE OF ILLUMINATION.

The theoretical principles on which carburetted hydrogen gas may be used with the best advantage, for the purpose of domestic illumination, have been so well laid down by the late Dr. Turner, and by Dr. Christison, as well as by other chemists, that it would be superfluous to enter at all on this part of the subject in a paper, the object of which is to give such practical directions for the proper construction and management of gas-fittings, as may lead workmen to give the requisite forms and proportions to the parts, and may enable the consumers to obtain the quantity of light they require, from the smallest practicable expenditure of gas, and with the least possible inconvenience from the products of its combustion.

It is very generally believed, by workmen and others, that the more freely the current of air is admitted to an argand burner, the better will be the light; and hence the burners and glass chimneys in ordinary use are made in such a way as to favour this view. No practice, however, can be more incorrect, or can lead to less economical results. An attentive observation of what takes place will show, *that there is only a certain proportion of air required for the favourable combustion of a definite measure of gas.* If more air than this due proportion be allowed to pass up the chimney, the size of the flame will be reduced, and the quantity of light diminished; if, on the other hand, less than the due proportion be admitted, the surface of the flame will be increased by elongation, but it will become obscure, and the quantity of light will decrease, owing to the escape of particles of unconsumed carbon. A simple experiment will exemplify this. If the flame of an ordinary argand burner be reduced, by partially shutting the cock, to about half an inch high, the light will be pale and blue, because the supply of air is too great for the small quantity of gas which is issuing. If partial obstruction be given to the access of air, by applying a handkerchief under the burner and chimney, it will be found that the size of the flame and the quantity of light emitted will increase until it arrive at a maximum, when, by farther obstruction, the admission of air will be reduced below the proportion required for the burning of the carbon, and the light will diminish.

It appears, therefore, that the proportionate size and shape of the burners, and the diameter and height of the glass chimneys, are by no means indifferent matters, but that much advantage may be gained or lost by giving them such forms and proportions *as may insure the development of the maximum degree of light which the gas is capable of affording.*

As a general rule, it may be considered that in all burners, whether well or ill made, the greatest quantity of light, *in proportion to the gas expended*, will always be obtained when the flame has been raised as high as it will go without smoking. In proof of this, the following experiment may be made. In any situation where there are three or four burners of the same size, and with similar chimney-glasses, and receiving their gas through a meter (by which the expenditure may be measured), if one of these burners have its flame elevated as high as it can be made to burn without smoking, and if its expenditure per hour be accurately noted on the meter, if the other two or three burners be then lighted, and their flames be so regulated that their united lighting power shall be just equal to the large flame of the first burner, it will then be found, on noting the expenditure, that it is much greater than in the case of the equal light from the single burner, and that the first burner, which gives light equal to two others, consumes but two-thirds of the gas which they do, or, if it be compared with three others giving together an equal degree of light, its consumption will be little more than half of theirs. It follows from this, that when a certain degree of light is required, such a burner should be employed as *is capable of giving this light and no more*, and that it is bad economy to use a more powerful burner with a flame of less than its due height. This rule holds good with any number of burners, and is equally true whether they be well or ill made.

The same rule will apply to the individual jets of an argand burner, as holds in regard to their united effect, and if, in any burner, the jets be of unequal heights, in consequence of bad drilling of the apertures, or neglect of keeping them free of dirt, the consequence will be, that

when the flame is raised until the jet from the widest hole reaches the most advantageous height, those from the obstructed holes will be consuming the gas at a disadvantage, which will be greater or less according to circumstances, but will always be of greater amount than is generally supposed.

The experiments made by Drs. Turner and Christison serve to show, that much smaller chimneys than those usually employed are required to burn the gas to the best advantage. Unfortunately, however, the dimensions most favourable to economy in one respect, are beyond the limits of economy in another; and when the glasses are made small enough in diameter to obtain the maximum of illuminating effect, they are liable to be softened by the heat; or to be cracked, *if not accurately centered.* A compromise between the two evils must therefore be made, and if this be judiciously done, *a great improvement on the usual routine practice may be effected, a more beautiful and steady light be obtained at a less cost, and our domestic comfort be increased, by the diminution of the heat and effluvia of the gas.*

For practical purposes, therefore, the following directions may be observed.

Whatever diameter is given to the burner, the glass chimney should not exceed it by more than half an inch at the utmost. If the burner be less than three-fourths of an inch in diameter, the chimney glass should not exceed 1¼ inch in internal diameter. In any case, its height should be no more than four inches above the mouth of the burner from which the jets spring.

The smallness of the interval which is in this way allowed between the flame and the glass, renders it necessary that the workmanship of the supporting gallery be accurate, *in order that the chimney may be held perpendicular, and truly concentric with the flame.* Gas-fitters rarely give sufficient attention to this important point, and a large share of the expense from broken glasses is owing to defects in this particular.

In the ordinary mountings, the gallery is put on the burner, which it seldom fits accurately, the glass likewise rarely fits tight into the socket of the gallery, and from these two causes, it is often so much off the centre, or so far from being upright, that the flame cannot be raised to a proper height without risk of breaking it. This risk may be greatly diminished by a little change in the disposition of the burner and gallery. Instead of hanging the gallery on the burner, it should be placed beneath it, and fixed by screwing down the burner on it. In this case, it is necessary to give the gallery an increased diameter, as the air, both for the inside and the outside of the flame, must enter through its ribs. The burners should also be made conical instead of cylindrical; but this is not so important as drilling them with numerous holes—at least double the number usually allowed, as the closer they are the better, the expenditure being regulated by the stopcock, and not by the number of holes.

In making the galleries, great attention should be paid to having the rim and seat for the glass truly concentric with the hole through which the nozzle-screw, on which the burner is fixed, passes; the workmen should have a solid wooden chuck of the size of the bells of the chimney-glasses, and should chuck the galleries on it, in order to drill the aperture through which the nozzle-screw is to pass. The outside and inside faces of this hole should at the same time be turned true, as, if this be done with the proper care, the glass, the burner, and the gallery, will all be true to the same axis, when they are put together and screwed up. The hole through the gallery should not be tapped, as the burner is sufficient fixture for it when screwed down over it. If this part of the work be well executed, even an indifferently made burner will perform well, and if it be ill done, the best burner will appear defective, and be liable to break the glasses.

The arrangement of burner and gallery here recommended is not incompatible with the use of plain cylindric glasses, but it will be found better to use what is sometimes called the French-shaped chimneys, that is, those which are used with the common argand oil-lamps. The wideness of their mouths gives them a firm seat in the gallery, and if the length of the bell, or wide portion of the glass, be such that the neck or choke shall be on the level of the lip of the burner, and the upper part of the glass be four inches to four inches and a half long, then a favourable result will be obtained. It is expedient to obscure the lower part or bell of the glass, as the burner is thereby concealed, and the flame appears to rise out of a thick wax-candle. No moon-shades should ever be used, as, besides intercepting a considerable portion of the light, they prevent the consumers from observing whether the burners and glasses be in good order, and performing properly.

It is pretty generally imagined that the smoking of ceilings is occasioned by impurity in the gas, whereas in this case there is no connection between the deposition of soot and the quality of the gas. The evil arises either from the flame being raised so high that some of its forked points give out smoke, or more frequently from a careless mode of lighting. If, when lighting lamps, the stopcock be opened suddenly, and a burst of gas be permitted to escape *before* the match be applied to light it, then a strong puff follows the lighting of each burner, and a cloud of black smoke rises to the ceiling. This, in many houses and shops, is repeated daily, and the inevitable consequence is a blackened ceiling. In some well-regulated houses, the glasses are taken off and wiped every day, and before they are put on again, *the match is applied to the lip of the burner, and the stopcock cautiously opened, so that no more gas escapes than is sufficient to make a ring of blue flame;* the glasses being then put on quite straight, the stopcocks are gently turned, until the flames stand at three inches high. When this is done, few chimney-glasses will be broken, and the ceilings will not be blackened for years.

Gas-fitters and lamp-makers generally put the stopcocks in situations where it is difficut to get at them, and they make their heads so small that, if they be in the least degree stiff, it is not easy to turn them gradually; hence, when a little force is applied, they move by starts, and the flame is sometimes raised too high, or, instead of being a little lowered, is altogether extinguished. The remedy for this inconvenience is to make the cocks easily accessible to a person standing on the floor, and to make their levers so long that their movements may be easily graduated. The cocks and levers may easily be designed so as to form part of the ornamental work of the lamps.

The argand burner being the most perfect and economical which can be used, unless where small portions of light are required, it is unnecessary to say any thing of the bat-wings and other fancy burners, especially as the only precaution to be taken with them, is to take care not to raise them so high as to smoke, and never to use two or more low flames, when the same degree of light can be got from one flame burning at its most effective height.

A mode of supplying argand burners with a current of heated air has been lately proposed in Paris, and much praised in London. This is effected by having an outer glass of a diameter a little larger than the inner one. This out r glass reaches farther down than the bottom of the burner, and is closed below by a metal plate; the air for the supply of the flame is made to pass down between the outer and inner glasses, where it gets heated; it then enters the inner glass and the centre aperture of the burner, and passing upwards, supports the combustion of the gas in the usual way. There is no doubt that, by this arrangement, a considerable improvement may be made in cases where ill-made burners, with wide and tall chimney-glasses are employed; but if the experiment be tried with burners and glasses proportioned in the way recommended above, it will be found that no advantage is gained, and that the maximum effect has been attained by a simpler apparatus.

Before quitting the subject of burners, it may be right to advert to a frequent cause of disappointment in their performance. The perfection of an argand burner is, *that the flame arising from it should appear in a continuous cylindric sheet, with a smooth upper edge, and without forking points.* This is sometimes very difficult of attainment, however carefully the jet-holes may be gauged by the pricker. There are two causes for this irregularity; one is, that, if the drill which is used be blunt, a little blaze is pushed aside by it when it is forced through the plate in which the jet holes are pierced; this blaze adheres to the edges of the hole, and interferes with the passage of the gas, and being unequal in its effects, renders the flame forked. The other cause is, that the inside of the burner is seldom turned true, and that the shoulder in which the pierced disk rests, is not of equal width all round, and sometimes may be so thick in some places, that the drill, when it gets through the disk, strikes against the shoulder; this likewise interferes with the issue of the gas. To avoid these causes of irregularity, the following precautions are essential. When the seat for the disk is turned out, the inside space between the inner and outer walls of the burner should be turned true for a quarter of an inch inwards, and no more shoulder should be left than just enough to support the disk in its place. The disk should then be put into its seat, but not finally fixed. The requisite number of holes should then be drilled in it, and slightly counter-sunk to take off the barb. The disk should then be reversed (that is to say, the counter-sunk face should be put inwards), and finally fixed in its place. The blaze which may have been pushed through with the drill will now be on the outside, and may be easily removed by the file, or by a slight counter-sinking, which is the preferable manner, as the smooth-edged holes will keep longer clean than those with a sharp arras, the application of an old tooth-brush being sufficient to keep them in good order.

The above observations apply chiefly to the illumination of the interiors of buildings, and it may be proper to notice the circumstances which require to be attended to in lights which, being placed externally, are in some degree exposed to the weather. The most im-

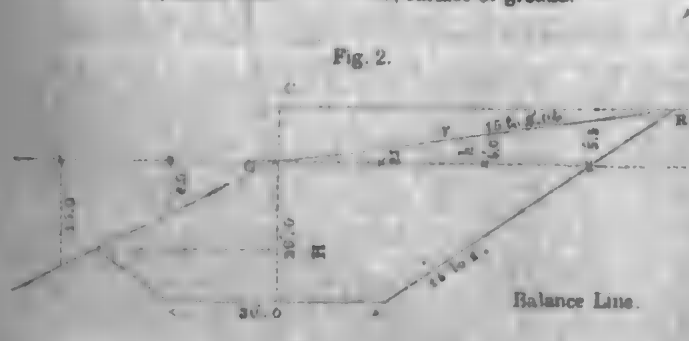
portant of these are the street lamps. These may either be arranged at considerable distances, and be fitted with powerful burners, or the intervals between them may be smaller, and only a single jet be allowed for each. Various local considerations must determine this, as well as some other points; but it should be kept in mind, that the best small light is either the single jet of three inches and a half or four inches high, or the fish-tail jet of three inches high, and that for more powerful lights *the argand is preferable to all others*. The large bat-wing, so much used in large public lamps, is wasteful, smokes the lantern, and does not give light in proportion to its expenditure.

In most towns, framed square lanterns are used for street lamps, as it is said that globes are apt to be obscured in cold weather by the deposition of the water generated by the combustion of the gas. It is no doubt true, that if proper precautious be not taken, this inconvenience would be felt, and the water which would trickle from the aperture in the bottom of the globe would be liable to freeze in severe weather, and so to close up the access for air, that the lamp would smoke or go out. In all other respects, globes have undeniable advantages over framed lanterns, as they protect the flames better in high winds, and they are kept up at much less expense.

Some years ago I pointed out to the commissioners of police of this city, that advantage might be taken of the acknowledged good properties of the globes for lighting the streets, and the alleged defect be obviated by constructing the tin tops with chimneys which should reach down to the points of the flames, and by their current carry off the water while still in a state of vapour, and so prevent it from being condensed on the sides of the globes. This plan was immediately tried, and having been found successful, was adopted in all the lamps erected subsequently. It occasionally happens, that from the jet being deranged, the gas is directed past the tin chimney instead of into it, and if the weather be cold, it is immediately observed that a deposition of water takes place inside the globe, and its sides become dim. The adjustment of the burner restores the proper action, and the globe remains bright. This plan having now stood the test of many years experience, may safely be recommended for adoption wherever new street lamps are erected.

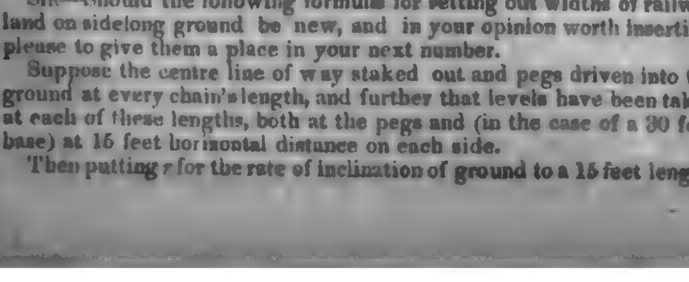
ON SETTING OUT RAILWAYS ON SIDELONG GROUND.

Fig. 1—Sidelong Ground.



C, centre line. G, surface of ground.

Fig. 2.



SIR—Should the following formulæ for setting out widths of railway land on sidelong ground be new, and in your opinion worth insertion, please to give them a place in your next number.

Suppose the centre line of way staked out and pegs driven into the ground at every chain's length, and further that levels have been taken at each of these lengths, both at the pegs and (in the case of a 30 feet base) at 15 feet horizontal distance on each side.

Then putting r for the rate of inclination of ground to a 15 feet length, R for the rate of inclination of slopes to a 15 feet length, H for height of balance line below or above surface at centre stake, h for difference of level between ground at centre peg, and at 15 feet on either side horizontal distance, and x for the actual height above or below balance line, at which the slopes run out to the surface.

We have $\frac{r}{R}x + H + h = x$ or $(H + h)R = Rx - rx$ or the height above the balance line, at which the slope cuts out on the higher side.—1.

$\frac{r}{R}x + h + x = H$ or $HR - hR = rx + Rx$, or the height above the balance line, at which the slope cuts out on the lower side.—2.

For example, in the case of a 20 feet cutting with base 30 feet, slopes 1½ to 1, and the surface of the ground varying in level from 3·9 feet above the centre peg,* at 15 feet on one side to 3·9 feet below at the same distance on the other side.

By formula 1, $(20 + 3·9)\ 10 = 10x - 3·9x$.

$239·0 = 6·1x$.

$39·2 = x$ at 1½ 1 $= 58·8, + 15 = 73·8$.

73·8 horizontal distance to be set off from centre stake on higher side.

Again, by No. 2, $\overline{20 \times 10} - \overline{3·9 \times 10} = 3·9x + 10x$.

$161· = 13·9x$.

$11·6 = x$.

At 1½ to 1 $= 17·2 + 15 = 32·25$ horizontal distance to be set off from centre stake on lower side.

It is here understood that these calculations are made in the evening after return from levelling, the depths of cuttings or embankments obtained by reference to a section run before hand over the centre line of way, and that the results of widths are pegged out on the following morning.

Another example is here added, in which the ground is shown as very irregular, although few instances occur to such an extent unless perhaps in Cornwall, &c. The depth of cutting and slopes with base same as before; levels supposed to be taken at A B C D on one side, and at E and F on the other. The extent of levels necessary must be left to the judgment of the party acting.

B 2·7	E = 8·
C 4·	F = 15·
D 5·5	
12·2 levels above A.	23· levels below A.

It is clear that in order to equalize the inclination of the surface, we must obtain a figure forming an arithmetical progression, in three terms to the amount of the higher side levels, but in two terms only to that of the lower.

Take 12·2 as before, of which 2·04 is the number required for the higher side inclination, and 23 of which 7·7 is the figure for the lower. Then according to our previous formulæ—

1. $(20 + 2·04)\ 10 = 10x - 2·04x$.

$220·4 = 7·96x$.

$27·69 = x$ at 1½ to 1 $- 41·53 + 15 = 56·53$.

56·53 to be set off as the horizontal distance from centre peg on higher side, correct ·9 of a foot.

Again No. 2. $\overline{20 \times 10} - \overline{7·7 \times 10} = 7·7x + 10x$.

$123· = 17·7x$.

$6·95 = x$ at 1½ to 1 $= 10·42, + 15$.

$= 25·42$ to be set off as the horizontal distance from centre peg for lower side.

I remain, your obedient servant,

GEO. B. W. JACKSON.

Radcliffe Terrace, Goswell Road,
April 27, 1841.

* The centre peg in this case supposed to be level with ground.

Stone Cutting Machine.—The *Alsace* (Strazburg) states that a native of that town, named Muller, has invented a simple and cheap machine, set in motion by the force of a single dog, turning like a horse in a mill, whereby a stone in its roughest state is in five minutes cut into a regular shape fit for building, and its faces have an unusual smoothness. This machine is capable of working twelve stones in an hour, or 144 in a day of twelve hours, being equal to the labour of forty men employed for the same time. Muller (adds the journal) possesses several quarries of stone, both hard and soft, and works his mill daily in the presence of numerous spectators.

IMPROVEMENTS IN RAILWAYS AND THE WHEELS OF LOCOMOTIVE ENGINES AND CARRIAGES.

In the first place, the leading and trailing wheels of locomotive engines either with four or six wheels would work better were each wheel to be keyed upon a separate shaft, so as to revolve independently.* This may easily be done in the following manner: let the wheels be keyed upon their respective shafts in the usual way, with either outside or inside bearings, which ever may be the most convenient, and let the shafts have middle bearings to meet in the regulating line common to all. If the wheels and axles are made in this way, the wheels on the outside rail would revolve quicker than those on the inside, and would allow the engine to find its own bearings. This would be particularly evident in going round curves, and would be the means of preventing many accidents from engines being very liable to be thrown off the rails on those parts according to the present system. In the second place, it is proposed that each of the leading and trailing wheels shall be keyed upon a hollow shaft, in the usual way; these shafts to have no external bearings, but to be bushed with brass bored to fit the solid shaft, or spindles which will be required to work into them. The solid shafts to have a bearing at each end, and one in the middle if required. This plan will allow the outside and inside wheels to revolve independently on the curves or otherwise, and will also prevent them wearing irregularly. Should any obstacle be thrown in the way of the engine, the wheels revolving separately would prevent it from coming off the rails, as the wheels would act as a check to each other, or as a complete check or guard rail on any part of the line as hereafter explained.

Thirdly. The wheels to be made of either wrought or cast iron, (the latter would be preferable,) and to have a flange on each side, by which plan they would not be required so strong as those now in use, because they would take the lateral concussions or side jolts more equally than the present kind. Should the engine be thrown to one side, both wheels would take an equal share of the strain or jolt, whereas in the present system the wheels on one side take the whole strain. This properly adjusted, the conical wheels may be dispensed with, as well as the check or guide rails upon the whole line, which latter checks are a great nuisance. In the plan thus proposed the rails would be laid level or horizontally across and not at an angle as at present, and the wheels would have to be the segment of a circle† upon the face, in place of being conical. Each wheel would thus act as a check rail for the other during the whole of the journey. Should the rails be out of gauge so as to cause the wheels on one side of the engine to mount upon their flanges, and throw the train off the rails, as is very often the case with the present system, the double flanges would obviate this evil and keep the engine in its proper course, until the wheels again found their places. The switches will remain without alteration, but the points may be altogether dispensed with. By this method of working, there will be a great saving in the wear and tear of the engines and rails, it will reduce the cost of keeping the engines and road in repair, and lessen the friction, as well as the quantity of fuel with all other expenses in like proportion. In constructing the permanent way much time might be saved, as no attention will be required in laying the rails to an angle, as they would then be horizontal where the road itself is straight. Giving to the outside rails the proper rise in the curves, the angle of the two rails will incline both one way, and not reverse to each other as at present. This will afford the engine another mechanical advantage on the curves, giving gravity a much greater opportunity of acting against the momentum of the machine. The engine will also be kept in its proper course in the curves much more forcibly than is afforded by the present method of laying railroads by the present system, as the angles of the two rails are acting against each other, the outsides of both being higher than the insides, and causing a great friction upon the axles, brasses, wheels, and rails; this the proposed alteration will entirely obviate. All the conical wheels now in use, through concussions and constant rolling upon the rails, squeeze out on one side. No conical wheels retain their proper form much longer than two months if daily at work; each wheel causes the flange of the opposite wheel to act with great force on the inside of the rail, and *vice versa*. The large hollow fillet that is left in the angle of the flanges of the wheels crushes down the inside angle or corner of the rails; which the proposed wheels would obviate—the weight of the vehicle would be also much better distributed over the surface of the rails. This alone is a great inducement to the introduction of double flanged wheels on loose axles, as the rails would last double the length of time.

In the fourth place, the double flanges would prevent the wheels squeezing out, as they seldom squeeze out on the side next the flange, and being all made from cast iron, there would be no spreading. The longitudinal shake or clearance that is generally given to the axles in their brasses will not be required, as the action of each being entirely in itself, and inclosed in brass, will retain the oil much longer and not require that attention which the present do. Were the engines and carriages made according to this arrangement the loss of power in the curves would not exceed from 8 to 10 per cent. above that used on a straight line, always of course depending on the radius of the curves.

In the fifth place, the whole of the engine and tender wheels should be furnished with double flanges, the latter to be of different diameters; causing thus different depths from the face of the wheel to the tops of those flanges. The reason of this will be easily explained.

Railways at present are nothing but a series of complication of curves, all differing in intensity. To carry engines round those continually changing curves without trailing and great friction, would require wheels of greater and less diameters, and this difficulty I propose to surmount by means of those flanges, which will become *bona fide* for the time the wheels of the machine.

To enable me to make use of the above arrangements, I propose to have radiated plates or segments put down on each side of the main rail, at such a depth from the face of the rail, as to cause the wheels to be lifted from the rail, and allow the flanges to act on those segments; the machine rolling at one time on the large flange, at another time on the small, and from thence on the face of the wheel, those alternations of course depending on the nature and radius of the curve. The length and position of those segments would be found by a calculation depending on the intensity of the curves.

Were engines, carriages, &c., provided with such wheels, and the railways with segments to suit, it would be next to impossible for the train to leave the line of road; for, even supposing the whole of the tires on one side were to come off, the train would be kept in its course by the double flanges of the wheels on the opposite side. At present if a single tire comes off, the engine is precipitated from the rails, and if without any more serious result, the train is detained till the arrival of another engine, train, or other means of locomotion.

I may in addition mention that the fatal accidents arising from furious driving which is more or less practised on all lines, and is a terror to all travellers who have not the iron nerves of his Grace the Duke, would be altogether prevented; for not even the velocity of 100 miles per hour could force the engine or carriages off the line, so firmly would the wheels be bound to the rails, and so sweetly would they glide round the curves if made on the above construction.

With many apologies for intruding my ideas on your acquaintance,

I am, your obedient servant,

William Andrews.

Paddington, March 26, 1841.

P.S. Were the wheels and segments calculated for each other, the parting or cutting of the shafts could be dispensed with, and they might remain just as they are at present.

W. A.

* Our correspondent will find that Mr. Coles has anticipated him, if he refers to the Journal for April last, where he will see described a method of making the wheels revolve independently of each other.—Ed.

† Wheels with concave rims were used on the Penryhn Iron Railway. See Repertory of Arts, &c., for 1803, page 285.—Ed.

MR. MUSHET'S PAPERS ON IRON AND STEEL.—No. 2.

Sir—It is my intention in this letter to make a few remarks on the latter part of the paragraph in Dr. Ure's dictionary (alluded to in my former letter) in which he says "the incorrectness of Mushet's statement becomes most manifest when we see the white lamellar cast iron melted in a crucible lined with charcoal take no increase of weight, while the gray cast iron, treated in the same manner, becomes considerably heavier."

This remark is as inapplicable to my table of proportions as the remark made in the former part of the paragraph. My experiments were confined solely to the changes produced in the character of iron by the fusion, not of cast iron, but of bar or malleable iron in contact with certain quantities of charcoal.

I have no where professed to account for the *alleged* fact that while white cast iron when fused alone with charcoal does not increase in weight, gray cast iron does, nor have I any where either asserted or denied that the fact is as stated by Dr. Ure, and I cannot help thinking that it is unfair in that gentleman, to raise up objections which have no foundation except in his own imagination, in order to throw them at what he calls my statement.

In my former letter the difficulty of obtaining an increase of weight in fusing cast iron alone with charcoal, is accounted for by the great

fusibility of that kind of iron which, before the high temperature necessary for the exertion of the greatest force of affinity, can be raised upon it as a solid, occasions it to pass into the fluid state, in which no union can take place between it and the carbon.

The table of proportions, as has been already observed, is a simple recapitulation of the results of the fusion of bar iron with given quantities of charcoal to exhibit the various states and qualities of cast iron and cast steel. By these results it appears that less charcoal is required to form white cast iron than to constitute gray cast iron, and, after forty years' observation and experience this is still my decided opinion. Dr. Ure on the contrary thinks that common white pig iron contains a maximum dose of carbon and that the grayest pig iron of the blast furnace contains less. Hence it may be inferred (according to the reasoning of Dr. Ure,) that white cast iron when fused with charcoal, does *not* increase in weight, because it is already so saturated with carbon as to be unable to take up any more, and that gray cast iron, when fused in the same way, *does* increase in weight, because it contains a comparatively small quantity of carbon, and can therefore absorb an extra dose in its fusion with charcoal; but in what quantity this absorption takes place, or to what extent, the reader is left to guess.

Dr. Ure, following Karsten, says that white pig iron contains from $4\frac{1}{2}$ to $5\frac{1}{4}$ per cent. of carbon, and gray iron from $3\frac{1}{2}$ to 4 per cent., but the gray iron may, according to Dr. Ure, be considerably increased in weight by its fusion with charcoal. If we suppose this increase of weight to be from 2 to $2\frac{1}{2}$ per cent. (from experiment I know it may be more), then we shall have, for the quantity of carbon in gray cast iron, the original quantity, from $3\frac{1}{2}$ to 4 per cent., and the experimental quantity from 2 to $2\frac{1}{2}$ per cent., making from $5\frac{1}{2}$ to $6\frac{1}{2}$ per cent. a proportion exceeding the maximum quantity assigned by Dr. Ure to white cast iron.

The following remarks will throw a little light upon the subject, and enable us to explain the phenomena without having recourse either to the theory of Drs. Ure and Karsten, or to the expedient of impugning the accuracy of the table of proportions.

Were white pig iron of a definite character, manufactured under the same cinder and circumstances in the blast furnace, and found to contain at all times the same quantity of carbon, it might be possible to arrive at some certain conclusion as to the results to be obtained by its fusion with charcoal. But if we consider that the white cast iron, particularly of this country, is generally made accompanied by a black or blackish brown cinder, containing portions of unreduced iron, it will be obvious that we have to deal with an impure and imperfect state of the metal, varying in quality as the proportions of carbon, oxide of iron, or earthy matter be absent or predominant. Hence the great difficulty of stating any thing definite on the subject, or of arriving at any satisfactory result, as we may use many different sorts of white pig iron, more or less pure, and containing more or less carbon to deal with.

By those who, like myself, have entered largely into this field of investigation, white cast iron has been estimated to contain from $1\frac{1}{2}$ to 2 per cent. of carbon, (and not from $4\frac{1}{2}$ to $5\frac{1}{4}$ per cent., as Dr. Ure has it,) together with a fraction of the unreduced ore and its accompanying earthy parts in combination with the iron, even when its fracture appears to be the most dense. The existence of these impurities is made most obvious in fusing white and gray cast iron in crucibles, and observing their molten surfaces respectively. The white iron, according to the degree of its impurity, presents upon its surface a quantity of slaggy matter, varying from $\frac{1}{2}$ to 2 per cent. on the weight of the iron, while, under similar circumstances as to fusion, the gray cast iron exhibits a pure convex surface without a trace of slag.

Again in the cementation of white cast iron by heating it in contact with charcoal, with a view to convert it into gray iron, should the process be interrupted after a few hours' exposure, the surface of the iron will be found covered with minute hemispheres of slag of various diameters (but none of them exceeding half a tenth of an inch), opaque, containing iron, and easily displaced. At a more advanced stage of the cementation, the hemispheres of slag will be found to have parted with their iron, to have become more brittle and transparent, and to cover small globules of iron which (as evidence of the reduction of the metallic oxide united to the iron before alluded to) have inserted themselves on the surface of the bar. When white cast iron with a polished surface is used in a similar experiment, the hemispheres of slag and globules of iron do not make their appearance, but oozings take place which form themselves into highly magnetic matters with a specular surface, adhering partly to the iron and partly found in the charcoal, from whence they are easily withdrawn by means of a magnet.

It seems obvious from these facts, that a portion of weight may be thus lost (namely the oxygen of the oxide and the glass which has been disentangled from the metal by a process of incessant reduction), sufficient to account for white or lamellar pig iron, or some sorts of it, not increasing in weight when fused in contact with charcoal, in as much as the sum by weight of the oxygen, an unreduced but separated oxide and earth, may equal, or amount to more than, the carbon absorbed during the operation, and make it appear not only that no increase takes place, but that actual loss is sustained without calling into question the disposition which white cast iron may have to absorb or repel carbon in its fusion with charcoal.

Were it possible to obtain white cast iron as free from oxide and earthy matter as gray iron, and were it to be found on experiment that such iron gains no weight by its fusion with charcoal, while gray iron does, I should be inclined in some measure to account for this (as in my former letter) by the early fusibility of the metal, and from its being a more rapid conductor of heat than gray iron, which causes it to enter into fusion before an absorbing affinity can be instituted between it and the charcoal, while the latter, being a worse conductor, remains longer as a solid in a high temperature to absorb the carbon. Some sorts of white cast iron pass into gray iron in the crucible with facility, but not with any material augmentation of weight, the oxygen, oxide, and earthy matters lost being equivalent to the carbon gained. In other white pig iron I have experienced a decided increase of weight, while its fracture remained apparently unaltered, but more frequently when the white iron was changed to gray.

The same anomalies attach to the scale of manufacture. Different ores tend, according to their constituent parts to produce various qualities of iron as to their degree of carbonization, and some, when smelted alone, uniformly produce white iron.

These various shades of quality all vanish in the crucible through the application and medium of lime, to which is to be added as much argillaceous schist only as will convert the lime into a pure porcelain slag. Fusion under these circumstances, and with $\frac{1}{80}$ the weight of iron of charcoal, will convert the most imperfect white cast iron into the most beautiful carburet, equal in point of saturation of carbon to any thing that can be produced in the reduction of iron ores in the crucible, and superior to any thing that is produced from the blast furnace. Under the most favourable circumstances, the increase of weight in these cases seldom exceeds $\frac{1}{2}$ per cent., while the same experiment made with gray iron would acquire an additional weight of from 2 to $2\frac{3}{4}$ per cent., clearly indicating the loss which is sustained in the fusion of white iron from the causes before mentioned.

Your's, &c.,

D. MUSHET.

Coleford, April 27, 1841.

QUERIES.

SIR—I should feel obliged if you, or any of your numerous correspondents could afford me any information on the subject of the instruments and machinery, which have been at various times invented for the purpose of assisting and facilitating draughtsmen in the correct delineation of existing buildings, under different titles, as the Camera Lucida, Perspective Machine, &c.; many improvements have of late years been made in this department, and it is of these that I wish to obtain information. And I cannot help thinking that it is far from being an unimportant subject to the profession, as it tends greatly to facilitate one great object of travel to the architect, viz., the obtaining of strictly correct delineations of the different structures which may fall under his notice, with the least possible waste of time. In conclusion, I hope that gentlemen may be induced to furnish the names, &c. of any instruments of this description they may have seen, in order that their relative value may be known, as it has often happened in this profession as in others, that inferior and inadequate instruments have been employed merely through ignorance of the existence of better. Hoping that you will pardon my troubling you.

I am, Sir, your humble servant,

ARCHT. ANGL.

SIR—If any of your readers could give me information on the following subject, I should be obliged to them.

How is the permanent way laid on the Greenwich arches? what is the cost of keeping it in repair? what thickness is there of ballasting between the rail and the extrados of the arch at the crown? and what is the cause of the feeling of rigidity, and of the jolting complained of on that line?

How are these points arranged on the Manchester and Birmingham, and other lines, where a railway is carried for a considerable distance on arches?

The comparative advantages of these methods, with any suggestions respecting them, will oblige

Your obedient servant,

May 3, 1841. A. B.

STEAM NAVIGATION IN AMERICA.

Written by Francis Anthony Chevalier de Gerstner, during his sojourn in the United States, in 1839.

[From the *Journal of the Franklin Institute.*]

1. *History and extent of Steam Navigation.*

Fulton, the North American inventor of steam navigation, constructed, in the year 1807, the first steam boat upon the Hudson river, to make regular trips between New York and Albany. The voyage of 145 miles was then performed in 33 hours. The success of this enterprise laid the foundation of steam navigation in the United States.

Up to that time the barks upon the Ohio and Mississipi were propelled partly by sails, partly by oars and poles; from Cincinnati to New Orleans (1600 miles), such a bark came down in five weeks, and went up in 80 to 90 days; for its management nine men were required down, and 24 to 32 up stream. In March, 1811, the first steam boat built by Fulton, in Pittsburgh, called the *New Orleans*, was launched on the Ohio, and commenced in December of the same year, to make regular trips between Natchez and New Orleans. The time required to make the trip of 300 miles between the two places was three days down stream, and seven to eight days up. The boat performed in a year only 13 trips up and down, or 7800 miles. A passenger paid 18 dollars for a passage down, and 25 dollars for one up stream.

Fulton constructed several other steam boats in the United States. He afterwards went to Europe, to bring into execution there, his important invention; but he found no encouragement in England, and when he proposed in Paris the introduction of steam navigation, he was derided by the French, and Napoleon declared him an adventurer. Five years elapsed, before Bell, in 1812, constructed the first steam boat at Glasgow, in Scotland. Steam navigation now came more and more into practice in Europe, but has as yet not attained such an extent there as in the United States, (except England.)

On the 6th of May, 1817, the first steam boat, the *Enterprize*, went up the Mississippi and Ohio, from New Orleans to Louisville, and arrived there on the 30th of May, or in 25 days. As the barks at that time required nearly three months for the same journey, the inhabitants of Louisville were in such an ecstacy, that they conducted the Captain Shrive, around in triumph, and gave him a public dinner. The steam boats upon the western and south-western waters were now constantly increasing in number, and in 1834, they counted already 234; in the year 1838, their number rose to 400. In 1831, there passed through the Louisville and Portland canal, in the State of Kentucky, 406 steam boats, and 421 flat boats, with a tonnage together of 76,323; in the year 1837, passed through the same canal, 1501 steam boats, and only 165 flat boats, with a tonnage together of 242,374.

In the year 1818, the first steam boat was launched on the great north-western lakes; in 1835, they were navigated by 25 steam boats, and in 1838, the number of steam boats was 70. In the year 1834, 88 new steam boats were built in the United States; in 1837, or three years after, 134 new steam boats were launched. The largest ship-yards for building steam-boats, are at New York, Philadelphia, Baltimore; at Louisville, New Albany, Cincinnati, Pittsburgh, and St. Louis.

In total, there were in the summer of 1838, about 800 steam boats in operation in the United States; the greatest number, in any one State, belonging to New York, viz., 140.

The travel in steam boats along the sea-shore has, as I observed in my former letters, been mostly superseded by railroads, located in a more or less parallel direction to the sea coast; and will, probably, when the whole railroad system is completed, entirely cease; but the steam navigation upon the navigable rivers is getting more into practice; its increase in the last two or three years, has contributed much to diminish the navigation with sailing vessels or barks; not only all kinds of merchandise without exception, but also provisions, as grain, flour, meat, &c., are carried in steam boats as well up as down stream, and while the freightage is almost the same as upon the barks and sailing vessels, the goods arrive much sooner at the place of their destination if carried in steam boats, and are, therefore, less liable to be damaged. But still more has been done. Upon the Ohio river, stone coals are now brought by steam boats, 250 miles, down to Cincinnati, or rather the flat boats, loaded with coal, are taken in tow and brought down the river by steam boats, and the empty barks taken back in the same way, because the cost of transportation is found to be less in this manner. It is true, the extremely high wages of the boatmen and all other labourers, contribute much to this extraordinary result; but, as I shall have occasion to show, hereafter, the crew of a steam boat is also very well paid, and it is to be ascribed entirely to the perfection in the construction of vessels and the engines used in them, and in the application of steam, as also to the improved arrangements in the steam boats generally, that they have produced in America the results which have been arrived at neither in England nor in any other part of Europe.

The Americans boast of a system of navigable streams in the southern and south-western states not to be met with in any other country of the globe; they maintain that the length of the Mississippi, with the Ohio and all other tributary streams, comprises an extent of 100,000 miles of water navigable by steam boats. I would not answer for the correctness of this number, but the Mississippi alone is navigated by steam boats from New Orleans, under the thirtieth degree, to the Falls of St. Anthony, under the 45th degree of north latitude, a distance not less than 2000 miles, and the number of navigable tributary streams of the Mississippi is indeed so large, that an European, who is accustomed to our short travels by steam boats, can only, by being an eye witness, conceive the magnitude of the system of steam navigation in this country. There are daily, at least four or five steam boats starting from New Orleans for Pittsburgh, in the business season, and as many arrive daily; the distance is 2000 miles, or two-thirds of that from England to New York across the Atlantic, and nevertheless the voyage is regarded as nothing extraordinary, and is undertaken after a few hours preparation.

2. *Construction of Steam Boats and the Engines used therein.*

The steam boats in America, with the steam engines used in the same, are of three entirely different plans of construction. Those upon the eastern waters, comprising the sea along the coast of Boston to Charleston, S. C., and all rivers emptying into the same, have condensing engines with large upright cylinders, and long strokes, the larger boats draw from five to seven feet water, and go with a speed of from ten to fifteen miles per hour. Upon the Hudson river, the distance from New York to Albany, of 145 miles, is performed in eleven to twelve hours up stream, and in nine to ten hours down stream, including the stoppages at fifteen or twenty landing places, where passengers come on board or leave the boat. I took a passage in the steam boat, *North America*, on the 23rd of November, 1838, from New York for Albany; as the river was already nearly half frozen over, a great deal of floating ice was coming down; the boat left New York at five o'clock in the evening, and arrived at Albany the following morning at seven o'clock; we made, therefore, including all stoppages, over ten miles per hour up stream. The length of the vessel is 200 feet, greatest width 26 feet; she has two decks, the lower of which, where the engines are, is about three feet above the level of the water; she has two separate cabins, the gentlemen's cabin, which is, at the same time, the dining room, and the ladies' cabin. We had 320 passengers on board, each of whom slept in a berth, and as sufficient room appeared still to remain, one may imagine how colossal this floating palace must be. Two steam engines with 52 inch cylinders, move the paddle wheels of 22 feet in diameter. The pressure of the steam of this, as of most of the steam boats upon the eastern waters, is about fifteen pounds per square inch, and the stroke eight to ten feet; the steam is generally cut off at one-third or one-half of the stroke, and operates by expansion. For a voyage of 145 miles, 25 to 30 cords (of 128 cubic feet) of soft wood are required. The *North America* draws, when loaded, six feet; but there are passenger boats upon other rivers in the east which draw, when loaded, only 24 to 30 inches of water, and move against strong currents.

The steam boats in the west, or upon the "western waters," are, throughout, very flat, and go, when loaded, generally five feet deep, some, however, only thirty to thirty-six inches. When the water in a river is only thirty inches deep, the steam-boat contains only the engine and fuel, and the cabins for the men, and flat boats loaded with goods are taken in tow. The passenger boats have two decks, the upper one is for the cabin passengers. The elegant boats contain a large splendidly furnished and ornamental saloon, used as the dining-room, and an adjoining saloon for ladies. The saloons are surrounded by small apartments, (state rooms), each of which contains two berths, and round the state rooms is an open gallery, to which a door opens from each state room. Such a vessel offers to an European an imposing and entirely novel aspect. All steam-boats upon the western waters have high pressure engines, the pressure of steam being from 60 to 100 pounds per square inch. Often two engines are used in a boat, and then each engine propels one of the paddle-wheels. The cylinders are horizontal, the stroke is eight to ten feet, and the steam is generally cut off at five-eighths of the stroke, and then operates by expansion. The escaping steam is applied to heat the water pumped from the river, before it gets into the boiler.

The third kind of steam-boats is to be found upon the lakes in the north and north-west of the Union, they generally go much deeper than the former, are more strongly built, and are propelled partly by condensing and partly by high pressure steam-engines.

3. *Progress of Steam Navigation since its introduction in the United States*

The perfection attained in steam navigation may be estimated after a comparison of the former and present performances of steam-boats, and of the former and present rates of charges for transportation of passengers and merchandise.

In the year 1818, a cabin passenger paid for a passage in a steam-boat from New Orleans to Louisville, a distance of 1450 miles, 120 dollars, and for returning, 70 dollars, the passages up took twenty days, and down, ten days; at present, cabin passengers pay, in the most elegant steam-boats, 50 dollars for a passage up, and 40 dollars for one down stream; while they go up in six, and down in four days. These charges include boarding, which, considering the abundance and choice of the victuals, &c., ought to be estimated at two dollars per passenger per day. The fare is, therefore, now, for the passage alone, taking the average between a trip up and down, (excluding board), 2·41 cents per mile. Less elegant boats take cabin passengers up in eight days, for 30 dollars, and for 25 dollars down in five days, which, after deducting one and a half dollars per day for board, gives only 1·22 per mile, at an average between a trip up and down.

Upon the lower deck of these steam-boats, which is a few feet above the surface of the water, are the deck passengers, who provide their own meals, and pay for the same passage of 1450 miles, only eight dollars; if they assist

the crew in carrying wood upon the boat, they pay only five dollars. In the former case they pay, therefore, per mile, 0·55 cents.

Merchandize was carried, before the introduction of steam navigation, in sailing vessels, which took a load of 150 tons; in the year 1817, the charge for freight per pound, from New Orleans to Louisville, was seven to eight cents; in 1819, the steam-boats commenced carrying freight, and immediately reduced the charge to four cents per pound. At present, the charges per one hundredweight, from New Orleans to Louisville, are according to the quality of the goods and the season, at least 33 cents, and at the most, one and a half dollars; at an average they may be taken at 62½ cents for the distance of 1450 miles. This makes 0·86 cents per ton per mile.

Between Cincinnati and Louisville, the first steam-boat, *General Pike*, was put in operation in 1819, and made, weekly, a voyage down to Louisville, 150 miles, in eighteen hours, and up again to Cincinnati in forty hours. A cabin passenger paid at that time twelve dollars for a passage. At present, the steam-boats have so much increased in number, that at least six boats are daily starting from and arriving at Cincinnati or Louisville. Upon the finest boats, as, for instance, the *Pike* and *Franklin*, the fare is four dollars, and the time occupied in going up is, including all stoppages, fifteen hours, and in going down only eleven hours; but these boats have frequently made a passage up in twelve, and a passage down the river in seven and a quarter hours; in the latter case the speed was therefore over twenty miles per hour. If one dollar be deducted for board, there remain three dollars for the passage, which is at the rate of two cents per mile. The deck passengers who assist in taking in wood, pay only one dollar, or two thirds of a cent per mile and find their own victuals. For merchandize, the charges are fifteen cents per cwt., or two cents per ton per mile.

From Cincinnati to St. Louis, the voyage is 538 miles down the Ohio, and 192 miles up the Mississipi river, making together 730 miles. The passage to St. Louis, or from there back, is performed in four days. A cabin passenger pays twelve dollars, of which we ought to deduct at least four dollars and seventy cents for board, this leaves only one cent per mile for the passage only. The deck passengers pay four dollars without board, which makes nearly one half cent per mile. Goods pay, at an average, 50 cents per one hundred weight, 1·37 cents per ton per mile.

Upon the Hudson river, the passage fare is, in the most elegant boats, three dollars for the distance of 145 miles between New York and Albany, which gives two cents per passenger per mile; for meals an extra charge is made. In less elegant steam boats, passengers are carried the same distance for one dollar, and at this moment even for 50 cents, which gives only one-third of a cent per mile.

From the above data we may infer that, at an average, cabin passengers upon the American rivers pay according to the elegance of the steam boats, from two and a half cents down to one cent per mile (board not included), and deck passengers only about one half cent per mile; both travel, taking the average between up and down stream, with a speed of 12 miles per hour. Goods upon the same steam boats are carried, at an average, for one and one-third cents per ton per mile.

These striking results, which are attained nowhere else, are chiefly derived from the improvements constantly made in the construction of the boats and their engines. Of the 800 steam boats at present navigating the American waters, hardly two will be found of an entirely similar construction; the steam engines, though subject to the same principles of steam power, differ from the English in nearly all their parts. But three years ago, eight days were required for a trip from New Orleans to Louisville, which is now regularly performed in six. The most remarkable result is, that a boat of 400 tons required, 20 years ago, for this voyage of 1450 miles, 360 cords of wood, while at present, for a six days passage only, the same quantity of wood is required.

4. *Rise of Wages, and of the Prices of all Requisites for Steam Boats during the last year.*

What appears most striking, is, that while the charges for transportation have been constantly reduced during 20 years, wages and the prices of all commodities rose from year to year. The captain of a steam boat received 20 years ago, a salary of 1000 dollars per year, now he gets, upon the better boats, 2060 dollars. Every steam boat has two pilots, who change every four hours; each of them received, in 1822, only 60 dollars a month, but since that time their salary has risen, and was, in 1833, 300 dollars, which is still now paid to the pilots of the best boats; there are also two engineers upon each steam boat, their salary was, in 1822, only 40 dollars per month, and rose in consequence of the great demand for engineers, to 100 and 150 dollars. The firemen and common labourers received, 20 years ago, only 14 dollars per month, and get now 30 to 40 dollars. The whole crew, besides, have free board upon the steam boats.

The provisions necessary for the nourishment of the passengers upon the steam boats, have risen in price during the last five years, 33 per cent.

The steam boats upon the western waters use, almost exclusively, wood as fuel for the engines, which, 20 years ago, was quite valueless; in 1834, it sold on the Ohio and Mississippi, for 1¾ to 2 dollars per cord, and costs at present 2½ to 3½ dollars; the price has therefore increased in the last five years, about 50 per cent.

5. *Cost of Steam Boats.*

The steam boats upon the western waters, whose plan of construction might be adopted to great advantage upon our rivers in Europe, are, as I observed already, principally constructed in Louisville, Cincinnati, and Pittsburgh. Generally, the hull of the vessel is built by ship carpenters, the steam engine delivered from a manufactory, and put on the boat, after which the joiners build the cabins and finish the whole. Three different classes of mechanics are therefore required, with whom separate contracts are made; there are, however, individuals who undertake the building and furnishing of a whole steamer by contract. As the prices differ much according to the solidity and elegance of the vessels, I herewith state the cost of some of the steam boats, which are among the best.

Between Cincinnati and Louisville, the two steam boats, the *Pike* and *Franklin*, make regular trips, carrying the United States mail; one of the two goes daily up, the other down, the river. The *Franklin* is 183 feet in length at her deck, and the extreme width is 25 feet, the depth of hold, or the distance from the keel to lower deck, is 6½ feet. The tonnage 200 tons. Upon the upper deck are 42 state rooms, each with two berths, making, in all, 84 berths; but mattrasses are laid upon the floor of the dining room, when required, and 150 cabin passengers may sleep upon the boat. The boat is propelled by two engines, the pressure of steam is *eighty pounds per square inch*, the diameter of the cylinders, which are in a horizontal position, is 25½ inches, the stroke seven feet. The steam is cut off at ¼ of the stroke, and acts through the remaining ¾ by expansion. The diameter of the paddle wheels is 22 feet, their width 11 feet, the dip is 22 inches, the paddle wheels generally make 28 revolutions in a minute. The length of the connecting rod is 23 feet. There are six boilers of wrought iron on board the boat, each 23 feet in length, and 60 inches in diameter, each boiler has two flues of 15 inches diameter.

At an average, the steam boat carries 125 passengers, one half in the cabins, and the other half on deck, and besides 25 tons of goods. With this load she draws six feet water. The boat was constructed in the year 1836, and the cost was:—

	Dollars.
For the hull, at twenty-five dollars per ton........	5,000
— two steam engines	12,000
— joiners' work for cabins	4,000
— draperies, mirrors, bedding, and other furniture in the state rooms, saloons and kitchen	9,000
Total	30,000

This boat is, as observed, one of the most solid and elegant; other steam boats of the same dimensions have cost 5600 dollars less.

Amongst the steam boats of the largest class, which run only between New Orleans and Louisville, the *Sultana* and the *Ambassador*, are now much favoured by the public; the *Ambassador* has 215 feet length of deck, and 35 feet extreme breadth. Her tonnage is 450. On the upper deck are 44 state rooms, each with two berths, but as many beds may be arranged upon the floors of the saloons. Of the two steam engines, each has a horizontal cylinder of 25 inches diameter and eight feet stroke; the steam acts with a pressure of *ninety pounds per square inch*, and is cut off at ⅔ of the stroke. The diameter of the paddle wheels is 22 feet, their width 12 feet. The boat generally carries 200 tons of goods up, and 300 tons down stream, besides 100 cabin and 150 deck passengers; she draws, empty, five feet, and when loaded, seven feet water. The hull of this boat has cost 12,000 dollars, the engines 17,000, the joiners' work, and the whole inner arrangement of this highly elegant structure, amounted to 31,000 dollars, making the cost of the whole boat 60,000 dollars. It must, however, be observed that great and costly alterations were made during the construction, so that her cost would actually not exceed 55,000 dollars.

Well instructed individuals, who are very much interested in the subject of steam navigation, estimate the average cost of a steam boat upon the eastern waters, at 45,000 to 50,000 dollars, upon the western waters, after a special calculation, at 23,500 dollars, and upon the lakes, the average between the two, or at 35,000 dollars. Consequently all the steam boats, which were in operation in 1838, have cost as follows, viz.,

			dollars.	
351	boats upon the	eastern waters, at	47,500	16,672,500
385	ditto	western	23,500	9,047,500
64	ditto	lakes, ...	35,000	2,240,000
800	steam boats, each at an average cost of.......		34,950	27,960,000

Now, as since the introduction of steam navigation, 1,300 steam boats were built in the United States; the whole capital invested by the Americans in steam boats, amounts to 45,435,000 dollars, the greater portion of which has been expended in the last five years.

(To be continued.)

New Motive Power for River Navigation.—A Brussels paper announces the arrival in that city of Dr. Beck, the inventor of the plan for navigating the most rapid rivers against the stream by means of a motive power that is represented to be without limits in its operation, and in which he uses neither steam nor wind power, nor hauling from the banks. It is stated that M. Wagner, of Franckfort, the inventor of the application of electro-magnetic power to navigate boats, &c., Dr. Bœttger, president of the Physical Society of Franckfort, M. Pauli, the first royal engineer of Bavaria, and many other distinguished scientific men, have proved by experiment the great advantages of this important invention.

ON WARMING BUILDINGS WITH HOT WATER.

An Answer to Messrs. J. Davies and G. V. Ryder's Report on Perkins' System of Warming Buildings by Hot Water. (See the Journal for April last, page 137.) By A. M. Perkins.

The excitement that has been occasioned by the destruction of Messrs. Craft and Stell's premises in Manchester, by fire, arising from the bursting of the furnace-coil of a hot water apparatus, on "Perkins' system of warming buildings by means of hot water," and the measures taken in consequence by the Manchester Assurance Company, have created an alarm as to the general safety of his plan, which the patentee feels it incumbent upon him to show is unfounded, and to prove that whenever accident has occurred, it may in every case be traced, either to the improper construction of the apparatus in the first instance, or to carelessness and mismanagement in the use of it. It appears by a report which has been extensively circulated by the Manchester Assurance Company, that a committee of the Directors of that company was appointed "to inquire into the nature of the accidents which have recently occurred from the use of hot water apparatuses, and to report thereon;" in pursuance of which resolution Mr. John Davies and Mr. George Vardon Ryder were directed "to institute a personal investigation into some of the cases referred to, and to make such experiments as might tend to satisfy their minds as to the causes of the accidents which had occurred."

In the report presented by these gentlemen to the directors, they commence by describing "the appearances observed" at some of the places which they visited. These appearances consisted of "wood, matting, and cushions, in a variety of places contiguous to the hot water pipes, having been charred to an alarming extent," and that Mr. Barbour's warehouse had "been on fire, *close to the pipes*, at different times and in different places." The Unitarian Chapel in Strangeways, also showed marked "appearances," the floor being charred black, and at the Natural History Museum in Peter Street, the matting on the floor had been charred, and the floor itself appears to have been scorched. The whole of these appearances were produced by one and the same cause—the overheating of the pipes; and this was doubtless occasioned by the disproportion of the furnace-grate and draught to the furnace-coil, like that erected upon Mr. Walker's own premises, for the purpose of Messrs. Davies and Ryder's experiments. Mr. Rawthorne's communication respecting the Strangeways Chapel affords sufficient evidence of an ill-proportion and ill-constructed apparatus, the deficiency of heat, great consumption of fuel, offensive scent, and charred wood, are convincing proofs that the quantity of tubing laid down in the chapel was insufficient to afford a proper supply of warmth; and the endeavour to procure more heat by extra firing sufficiently accounts for the great consumption of fuel, and the offensive scent given out by the pipes when thus overheated. In an apparatus justly proportioned, the water circulating in the pipes can receive but a given quantity of heat, and any fuel added beyond that point would not cause them to become overheated. It is necessary here to describe what "Perkins' system of warming" really is; for the patentee utterly disclaims the apparatus experimented upon by Messrs. Davies and Ryder as his, any further than that the pipes were closed in all parts.

Perkins' apparatus, then, consists of a continuous or endless tube, closed in all parts, a portion of which is coiled and placed within a *duly proportioned* furnace; from this coil the rest of the apparatus receives its heat by the circulation of the hot water flowing from its upper part, and which, cooling in its progress through the building, returns into the lowest part of the coil to be reheated. The expansion of the water, when heated, is fully provided for by the expansion tube, which is of three inches diameter, and of sufficient length to afford an expansion space of from fifteen to twenty per cent; this, long practice has proved, is ample for the greatest heat which can be attained by the water, as it expands only five per cent. from 40°, its point of greatest density, to 212°, the boiling point. This tube is placed at the highest part of the apparatus, and is empty when the water is cold; the furnace is provided with a damper, by which the fire may be regulated at pleasure. In a well managed apparatus this damper is in general nearly closed after the fire has become well ignited. and the draught is so regulated that little more than a slumbering fire is kept up, which at once economises fuel and prevents the possibility of the pipes being overheated. The degree to which the damper should be closed depends entirely upon the goodness of the draught; and a very few days'—even a few hours' experience will show the person in charge of the apparatus the point at which it is desirable to keep it. To most of the apparatuses recently erected by the patentee, a self-regulating damper has been attached, acting from the expansion and contraction of the pipe; when this becomes heated beyond any given point to which the damper has been previously regulated, the elongation of the pipe by the excess of heat acting upon the handle of the damper, partially closes it; the draught is thus checked and the fire lowered; the pipe consequently cools, and, in cooling, contracts; the contraction again opens the damper and the fire is revived. By this action of the self-regulating damper any degree of heat from the pipes may be maintained within a few degrees; if the damper be so fixed as to work the apparatus at 250°, it will be found that the heat of the pipes will range between 255° and 245°, whatever quantity of fuel may be thrown upon the fire; thus again the overheating of the pipes is effectually prevented, and an equal temperature at the same time obtained.

In the arrangement and fixing of any apparatus, regard ought always to be had (as has been already stated) to the due proportions of grate surface, heating surface, conducting and radiating surface, and draught; and where these have been duly observed, accident becomes impossible, even if the damper should be left wide open. It is not deemed necessary here to state the proportions the above surfaces should bear to each other, but their necessity is sufficiently obvious; an unlimited supply of heat arising from an excess of fire or heating surface and draught, with a limited means of carrying off that heat, must cause overheating somewhere, as is proved by the high temperature of the apparatuses at Birch Chapel, Mr. Barbour's Warehouse, the Strangeways Chapel, and the Natural History Museum; while, on the other hand, the due observance of these proportions renders an apparatus upon this system perfectly safe. Nor can it be considered that, in claiming attention to the foregoing points in constructing an apparatus, the patentee demands too much; it is the duty of every tradesman who undertakes to erect these apparatuses to understand them; and to such an one what has been said presents no difficulties; and surely common care and the usual degree of prudence required from every person attending upon fires may reasonably be asked for in the management of a hot water apparatus.

After this brief description of what a hot water apparatus erected upon Perkins' system ought to be, it is necessary now to examine whether the apparatus erected in Mr. Walker's premises, and experimented upon by Messrs. Davies and Ryder, is to be considered as an apparatus upon Perkins' system, and what degree of weight ought to be attached to experiments conducted as they were, and upon such an apparatus. It appears from the report of those gentlemen, that it consisted of 140 feet of tubing, of which 26 feet were coiled in the furnace. With these proportions of tubing no fault is found; but it seems from the diagram annexed to the report, that only 15 inches of expansion tube was attached to it (at least only that quantity was left unfilled with water), which, supposing it to be of three inches diameter, the largest size used, is six inches less than the apparatus required. This, in so small an apparatus, is a serious difference when worked at a very high temperature; still, however, under ordinary circumstances, the apparatus would have worked. The *damper* is not once mentioned in the report, nor does it appear that it was ever made the slightest use of during the experiments, so that the full force of the draught was admitted to the furnace at all times unchecked, even when it was loaded with fuel to repletion. This might suit the purpose of those who erected this apparatus with the express view of making it as dangerous as air, fire, and water, recklessly employed, could make it; but what tradesman would introduce one so constructed into his employer's premises? But more could yet be done to increase the dangerous tendency of this apparatus; and, accordingly, in the absence of Mr. Walker, a stop-cock was introduced, which, cutting off the greater part of the circulation, left only *forty feet of the tubing* out of the furnace, to carry off all the heat that could be communicated from *twenty-six feet within it*, with a fire out of all proportion to those surfaces, and a draught totally unchecked. With the apparatus in this state—a state in which no man in his senses ever before thought of working one, and which, it may be safely asserted, had never before occurred since the introduction of warming by hot water—preparations were made for an explosion. The process of "igniting," "destroying," "fusing," "inflaming," and "charring," various substances, went on most prosperously, and, at length, the desired explosion took place, the fire was thrown violently out of the furnace, and the ignited embers were scattered in profusion over every part of the place. Some gray calicos spread around the furnace were alone wanting to complete the scene, and put the finishing touch to this exquisite specimen of "Perkins' Hot-water Apparatus."

But can it be seriously intended that an apparatus thus erected, and thus worked, is to prove the *danger*, and caution the public against the use of Perkins' system of warming by means of hot water? Is the abuse of a thing to be used as an argument for discontinuing the use of it? To what invention will not such reasoning apply? Steam-engines, railways, all must vanish before it, since, if great skill and care are not employed in their construction, and much caution and prudence in their application, they become imminently dangerous.

Messrs. Craft and Stell's premises were burnt down; the fire was caused by the bursting of the furnace coil of the hot-water apparatus, which threw the ignited embers among combustible materials, and set them on fire. But was common precaution used in placing the furnace in such an apartment (the very walls of which were boards), and in surrounding it with grey goods? Would not a vault or a cellar have been a more appropriate place? and had the furnace been so situated, would the premises have been destroyed by the explosion which took place? This explosion was caused by a stoppage in the pipes; the water in them was frozen. It appears the warehouse was closed on Saturday evening, and not opened again before Monday morning; the frost being intense during the two intervening nights. A fire lighted in the furnace on Sunday morning was an obvious means of preventing such an occurrence; and it might have been supposed would have naturally suggested itself. Weather of such extreme severity is not very frequent in England, and the short time required for such a purpose (the necessity of it being evident) could scarcely be considered a desecration of the day. And even after the pipes were frozen up, common attention on the part of the fireman would have shown him the circumstance in a few minutes after the fire was lighted; the want of any circulation in the pipes being always indicated by their great heat near the furnace and their coldness in every other part. Had the fire then been raked out and the most exposed part of the pipes been thawed by the application of heat to them externally, the circulation might have been restored, and all would have been well. No precautions, however, of any

kind appear to have been taken, and the endeavour to force a circulation in the state the pipes were then in, produced the disastrous event that ensued. It is not the object of the patentee to throw blame upon others, he only wishes to show that his apparatus may be used with perfect safety, if the same care and attention be bestowed upon it, as is required by every other mode of warming.

There are some palpable errors in the report of Messrs. Davies and Ryder in their remarks upon the inequality of the heat given out by the pipes in the Natural History Museum, and the manner in which they attempt to account for it. They observe, that the heat in those pipes had been repeatedly stated to become the greatest at places remote from the furnace, and that the fact was confimed by their own observations and subsequent experiments; and in another part of the Report they account for it by stating, that the minute bubbles of steam which rise rapidly to the upper part of the flow-pipe become there condensed into water again. From this acknowledged fact they deduce the inference that, "as condensed steam wherever it occurs produces about seven times as much heat as the same quantity of water at the same temperature, we have at once a reason for the heat of the pipe being generally greater at a distance from the furnace than contiguous to it." This is a manifest absurdity, for it is impossible that increase of heat can be produced by the condensation or cooling of steam. There cannot, therefore, be the slightest doubt that the statement of those gentlemen, that the heat is generally greater at points distant from the furnace than contiguous to it, is founded altogether in misconception and error. Another observation from which erroneous conclusions are drawn is, that the temperature of the pipes is influenced by the variation of their internal diameter, this is not the case; the amount of heat conducted off depends upon the surface exposed to the atmosphere, and not upon the internal diameter. Equal surfaces exposed to the atmosphere give off equal heat, whatever variation there may be in the velocity of the current of the water within the tubes.

The objection No. 1, relative to the possibility of an explosion from the inadequacy of the expansion tube, has been already met in the description of the apparatus in the former part of this paper; and overfilling the apparatus is impossible while the filling-pipe is made the only medium of supplying it, and the screw-plug of the expansion tube is at the time of filling taken off.

In objection No. 2, it is inferred that, because a pint of water may be converted into steam capable of exerting a powerful mechanical force, and present a pressure upon the tubes "sufficient to ensure their destruction," that such must inevitably be the case. Ten years' experience has, however, próved the contrary; any quantity of steam which can be formed in an apparatus properly put up, the tubes are perfectly able to resist.

Objection No. 3 supposes the presence of hydrogen gas in the apparatus to be a common occurrence, instead of a very rare one; and where it has occurred it has invariably arisen either from a faulty construction of the apparatus, or great neglect in its management. Admitting, however, that hydrogen gas has been formed within the pipes, no explosion can be produced by its expansion, as its expansive power is far less than that of water; neither can it explode within the pipes by ignition, as it requires an admixture of atmospheric air to render it explosive.

The remaining objection urged against the use of the apparatus is, the danger of explosion from stoppage in the pipes. This is a very unusual occurrence, and rarely happens except in seasons of very severe frost, when it may always be prevented by keeping a slumbering fire. The addition of three per cent. of salt to the water will also prevent it from freezing, even during such severe weather as was experienced last winter. The objection of stoppages by extraneous substances getting into the pipes, is scarcely worth notice; the last operation of the workmen in erecting a new apparatus is always to scour the pipes well through by means of a forcing pump, and then to close them up. How then can any substances get into pipes thus closed in every part, except by design?

It seems that previously to putting up the apparatus at Mr. Walker's, those at the Natural History Museum, and Messrs. Vernon and Company's, had been tried and found "unsatisfactory;" that is to say, they could not be sufficiently overheated. The patentee can show Messrs. Davies and Ryder some hundreds of apparatuses that would prove still more "*unsatisfactory*" to them than those just named. Since the foregoing remarks were written, Mr. Perkins has received a letter from Sir Robert Smirke, in which that gentleman says, "I am sorry to know that you think the partial use of my answers to the questions sent to me from Manchester (as printed in the Report there) has been in any degree prejudicial. If it has been so, I think you ought in the reply you are about to publish, to counteract that effect, especially as it was one not at all intended. They should, at least, have directed equal attention to my remark that complete security, under every contingency, might be obtained from the adoption of your safety-valves."

Comment upon this is unnecessary; it only strengthens the feeling which the perusal of Messrs. Davies and Ryder's Report has very generally produced, viz. that it is very unjust, and that the absurd experiments detailed in it were conducted with any view rather than that of candid investigation.

If those who possess the means of obtaining the information would make known the causes of all the fires that have come under their cognizance within the last eight or ten years, as far as they can be ascertained, the patentee is confident that such a statement would speak more in favour of his apparatus than the most laboured arguments. There are not wanting, however, many persons even in Manchester itself, who, placing more confidence in their own knowledge of the apparatus, founded on several years' experience, than in the Report, have unhesitatingly expressed their determination to continue the use of it as heretofore.

The safety-valves, alluded to by Sir Robert Smirke, have been but recently applied; and effectually provide for any casualty which can arise from a stoppage in the pipes.

In conclusion, the Patentee begs that the Directors of Assurance Companies, and the public generally, will not hastily form their opinion of Perkins' hot-water apparatus from the very erroneous reports which have been circulated respecting it, as it is his intention to request a committee of competent gentlemen connected with insurance offices to inspect an *apparatus properly constructed*, and which he *wishes* to have subjected to any test to which such committee may think proper to submit it.

6, *Francis Street, Regent Square,*
April 10th, 1841.

LOCOMOTIVE ENGINES IN AMERICA.

We have received a copy of the Annual Report of the Canal Commissioners of Pennsylvania. Among the documents thereto appended, is the report of the superintendent of motive power on the Philadelphia and Columbia railroad, in which an engine built by Mr. Ross Winans, of this city, is spoken of in the most flattering terms, which applies not only to the particular engine, but to the class of engines built by Mr. Winans. We extract the following from the report:—"In addition to the different engines of the ordinary construction purchased by the undersigned, is one built by Ross Winans, of Baltimore, which, as well as others, was contracted for by a resolution of the Board, previous to the date of my last report. The general principle upon which this engine is constructed is similar to the one which, by the order of my predecessor, had been placed on the road near a year before my appointment. It is, however, entirely different in its proportions.

"This engine was constructed by special orders, as an experiment in the use of anthracite coal as a fuel to generate steam; and, on trial, has met all my anticipations. It is very large and heavy, with more than double the power of any other machine on the road. It burns anthracite coal exclusively, and from the additional space of fire-box, obtained by its increased size, has advantages in the use of that article, which is not, and which cannot be possessed by any other plan of engine. It is intended exclusively for the transportation of heavy trains of burthen cars. It will haul double the ordinary train, but owing to its great weight, must be run very slowly over the road."

We have understood that this engine rests its entire weight on *four propelling* wheels, each wheel supporting about the same weight as each one of the *two propelling* wheels of the largest class six wheel engines on the Philadelphia and Columbia road. The engine last built by Mr. Winans, and which we have before noticed, is still more powerful than the one spoken of in the report; but having overcome the difficulty that has heretofore been deemed insurmountable, of placing eight wheels under his engine, and connecting the motive power with all of them, so as to get the adhesion of the entire weight, without having a weight on any one wheel which is oppressive to the road. The engine now furnished weighs 19·33 tons, when in running condition, and is mounted on eight propelling wheels, which divide the weight equally among them, putting 2·42 on each wheel. The passenger engines of Norris' construction, in such extensive use, weigh about 10 tons when in running condition; but as they have only two propelling wheels, the greatest adhesion which they can render available, is that resulting from 6·70 tons resting on the driving wheels, which is but little more than one-third the adhesion obtained by Mr. Winans' eight wheel engine, while the weight on each driving wheel of the Norris is 3·35 tons, nearly a ton more than the weight on each wheel of the eight wheel engine. The power of every locomotive engine is limited by the greatest adhesion of its wheels on the rails; the adhesion is directly as the weight resting on the propelling wheels collectively. The greater the weight bearing on any one wheel the more destructive to the road. The greatest economy in transportation results from the use of the most powerful engines that can be employed consistent with the strength and character of the road on which they are to run; hence the advantage of increasing the number of propelling wheels.

An account was published a few days since, in a Philadelphia paper, of a gross load of 481½ tons being drawn over the Philadelphia and Reading Railroad, by an engine built by Messrs. Baldwin, Vail and Hufty, the weight of which is stated to be 11·92 tons, and the weight on the driving wheels 6·30 tons. As this is less than one-third the weight on the driving wheels of Mr. Winans' eight wheel engine, which has been shown to work to the full extent of its adhesion, it follows that it would be capable of taking over the Reading road three times the amount of the load above-named.—*Baltimore Clipper.*

The Railway Guard's Whistle.—Upon one of the London and Birmingham trains an apparatus is fitted up, consisting of rods attached to every carriage, and under the control of the guard, communicating with a whistle on the engine, called the "guard's whistle," quite distinct from the one sounded by the driver, and used only to give warning to him, to increase or decrease his speed, to stop, &c., according to signals previously a ranged and under-ood.—*Yorkshire Gazette.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

February 9.—The President in the Chair.

Mr. S. Seaward explained the Table of Velocities of steam ships, which accompanied his paper. (See Journal for last month, page 168.)

The top line of figures represents the number of horses power, ranging from thirty to three hundred. The side line gives the tonnage of the steam ships, rising progressively from one hundred to twelve hundred tons. The intermediate spaces show the number of knots or nautical miles, which a ship of given tonnage, with a certain power, will travel through still water per hour.

The tonnage is calculated by the old rule (13 George III. cap. 74): "From the length substract $\frac{3}{5}$ths of the breadth, multiply that sum by the extreme breadth in the widest part, and again by $\frac{1}{2}$ the breadth, divide the product by 94, and the quotient will be the true tonnage."

The Table is constructed upon the principle, that each vessel of a good modern form will carry, at a proper draught, a weight equal to her measurement tonnage, and is presumed to be loaded equal to her tonnage, either by the weight of her engines, fuel or cargo, and it terminates at thirteen knots, at which speed the engines alone become the full load of the ship. The mode of constructing and of using the table was fully described, and examples were given.

It was shown, that an engine of thirty horses power would propel a ship of twelve hundred tons burthen, at the rate of 4 knots per hour, while three hundred horses power would only propel the same ship at the rate of $10\frac{5}{8}$ knots per hour. Hence, ten times the power would only produce about two and a half times the speed.

The principal points in the paper were more fully dwelt upon, and in answer to questions from some of the members, Mr. Seaward remarked, that no steamer in England had ever been propelled at more than fifteen geographical miles per hour, through still water.

In some of the Government mail packets, the engines and coals were the full cargo of the vessel. The table did not apply to vessels overladen with power, for as the weight increased in the ratio of the power, so the immersed sectional area was augmented, and the lines of the vessel which might be well calculated for speed when at a proper draught, became lines of retardation, and the engines did not work up to their proper speed, owing to the depth to which the paddle floats were immersed. For instance:—The wheels of the "British Queen" have been plunged between six and seven feet, instead of four feet, which was the calculated dip; the engines at the same time diminishing their speed so much as to reduce the effective power from five hundred horses to nearly three hundred horses.

The only advantageous way in which great power could be applied, would be by contriving to prevent the increase in the weight of the machinery and fuel, and those engineers, would be most successful who could so apply the materials of construction, as to ensure strength without the usual corresponding increase of weight.

Mr. George Mills, from his experience as a ship-builder, at Glasgow, was enabled to confirm all that Mr. Seaward had advanced. On the Clyde, the employment of an excess of power in steam vessels had been carried to the greatest extent, without producing corresponding advantages, either for speed, or in a commercial point of view. It would appear that the same error had to a certain degree been committed on the Thames, but less than on the Clyde; for on the latter river there were vessels with nearly double the power, in proportion to size, as compared with any vessel on the former river. He believed that on the Thames no vessels had so much as one horse power for each register ton, whereas on the Clyde, there were steamers of seventy to eighty tons register, having single engines, with cylinders of fifty-four inches diameter, which was more than one hundred horses power. It would appear that this application of extra power had only obtained a very moderate speed, while the great first outlay, with the commensurate current expenses, had reduced the commercial profit to the lowest point,—of this the proprietors alone could give any account; but as to the speed attained, he had seen three steamers of identical tonnage leave the Broomielaw at the same time, their engines being respectively of one hundred and ten, eighty, and sixty horses power; yet their speed was in the inverse ratio of their power: the vessel with the smallest engine arrived at Greenock first, the greater power second, and the greatest last. These remarks were only applicable to river boats. With regard to sea-going vessels, the system had not been carried to so serious an extent, yet with them the average proportion was about one horse power to two register tons, and some few reached as high as one horse to one and one-eighth of a ton.

As an example of an augmentation of power producing an opposite result from that which was intended, Mr. Mills mentioned two vessels called the "*Tartar*" and the "*Rover*," built by him and his (then) partner, Mr. Charles Wood. They were each of about two hundred and twenty tons register, built from the same draught, and in every respect as similar as possible—except that the engines, which were by the same maker, were respectively of one hundred and seventy, and one hundred and thirty horses power; yet whenever they worked together, the one with the smaller power proved herself the faster vessel, either in a calm, with the wind, or even against it. The "*Achilles*," Liverpool steamer, which lately had an addition of thirty feet to her length, and eighteen inches to her breadth, augmenting the tonnage about one-fifth, had improved her speed upwards of one mile per hour, although she carried a much heavier cargo than before.

He had built a vessel of five hundred and sixty tons register, with engines of one hundred and thirty horses power on board—a proportion of power to tonnage of one to four; the stowage for cargo was ample; the accommodations for passengers excellent. She drew little water, and her speed was much greater than vessels of double her power. Yet in spite of all this, the vessel could not find a purchaser, because the power was not nominally large.

It would be asked—why, with these and so many similar instances, such a system was continued? It was not likely that the engineers would complain of having orders for large engines; and there were certain dimensions prescribed for the vessel, to which the ship-builder was under the necessity of conforming.

The chief cause of mischief, however, was the fiat of the public. It was believed that a great power would remedy want of speed and all other evils, and it was found indispensable for ensuring the confidence of travellers. Hence, the shipowners, who depend upon the public for support, were obliged, against the conviction of their experience, to keep up the errors occasioned by ignorance.

The President observed, that the condemnation of large power should not be carried too far, as experience alone had produced the increase of weight, strength, and power, of the present engines, compared with those of the early steamers which were built, instancing the *Halifax Packets* (Cunard's), which, with their great power in proportion to tonnage, had performed their duties satisfactorily.

Mr. Mills explained that the Halifax Packets were built for the especial purpose of carrying the mails only, to perform the voyage in a given time,—about twelve days. The engines were built by Mr. Robert Napier, after the model of those of the "Great Western," which used their steam expansively; similar provisions had been made in the Halifax Packets, but the expansion valves were seldom used.

Mr. Field agreed with the principal part of Mr. Seaward's paper, but he would prevent an erroneous conception of the term *overpowering* a steamer. A vessel could not have too much power, provided that power could be advantageously applied, without causing too deep an immersion. A good result could be produced only by keeping a proper proportion between the machinery, the vessel, and the paddle wheels, and immersing the hull of the steamer only as deep as the true lines of draught.

Mr. Vignoles observed, that in this country the reputation of engineers depended upon the commercial success of the works they engaged in. An erroneous public opinion might have influence at present; but if the engineer and ship-builder would determine to break these trammels, and produce such vessels as should force conviction upon the public mind by the speed attained, and show the proprietors the consequent commercial advantage, the present system would soon be abandoned.

Mr. Parkes eulogized Mr. Seaward's candour in describing the errors in the first construction of the engine on board the Vernon; more was frequently to be learned from failures than from successful efforts, and no communications to the Institution would be so useful as those which gave accounts of defective design or construction, with the details of the methods adopted for remedying the defects. He directed attention to the performances of the "Great Western" steam ship, which at least equalled those of the Halifax Packets, without the disadvantages of being unable to carry cargo, or of shipping so much sea, when the weather was foul. The important feature of economy of fuel on board the "Great Western" might be in part attributed to the use of steam expansively. It was very desirable that the Institution should possess very full drawings and a description of the "Great Western," so as to be enabled to compare them with those of the Halifax Packets, which had been promised by Mr. George Mills. He would impress upon manufacturers of marine engines the necessity of adopting a correct and uniform nomenclature of the power placed on board steam vessels. The nominal sailing power did not accord with any calculation.

Mr. Field believed the Table of Velocities calculated by Mr. Seaward to be very nearly accurate. The speed of the "Great Western," when loaded to her proper draught, has been as high as $13\frac{5}{10}$th miles through still water. There was an error in the alleged speed of Cunard's vessels; they reached Halifax in ten days, Boston in three days more, and then had still one day's voyage to New York. The average duration of the voyages of the "Great Western," was about fourteen days and a half. If two hundred tons were deducted from the tonnage of the "Great Western" for cargo and the accommodation for the passengers, she would then be similar to the Halifax Packets. The engines of the "Great Western" were nominally estimated at four hundred horses power, and the average consumption of fuel was twenty-six tons every twenty-four hours.

During the discussion, Mr. Cubitt had calculated the following Table, showing the rates of velocity which would be attained by substituting engine power, with its consequent weight of one ton per horse power, for cargo, so as to preserve the draught of water the same in all cases.

Mr. Seaward remarked, that his Table of power and velocities was corroborated by Mr. Cubitt's—the practical results verified both. The great difference between the "Great Western" and the Halifax Packets consisted in the better adaptation of weight and power to tonnage, and the more economical consumption of fuel of the former over the latter—the one carrying

cargo and passengers, the other only the engines and fuel, yet the "Great Western" travelled farther with the same quantity of fuel.

TABLE showing the power required to obtain various rates of speed in a steam vessel, where the total weight of cargo and engines remains in all cases the same, and in which, with a power of 30 horses, a speed of 5 miles per hour is obtained; the total weight carried being in all cases 1000 tons, and the engines weighing 1 ton per horse power.

Weight of Cargo.	Weight and Power in Tons and Horse-Power.	Relative speed.	Speed in miles per hour.
970	30	$5\sqrt[3]{1}$	5·
940	60	$5\sqrt[3]{2}$	6·299
910	90	$5\sqrt[3]{3}$	7·211
880	120	$5\sqrt[3]{4}$	7·937
850	150	$5\sqrt[3]{5}$	8·549
820	180	$5\sqrt[3]{6}$	9·085
790	210	$5\sqrt[3]{7}$	9·564
760	240	$5\sqrt[3]{8}$	10·
730	270	$5\sqrt[3]{9}$	10·4
700	300	$5\sqrt[3]{10}$	10·772
670	330	$5\sqrt[3]{11}$	11·119
640	360	$5\sqrt[3]{12}$	11·487
610	390	$5\sqrt[3]{13}$	11·756
580	420	$5\sqrt[3]{14}$	12·050
550	450	$5\sqrt[3]{15}$	12·331
520	480	$5\sqrt[3]{16}$	12·599
490	510	$5\sqrt[3]{17}$	12·856
460	540	$5\sqrt[3]{18}$	13·103
430	570	$5\sqrt[3]{19}$	13·34
400	600	$5\sqrt[3]{20}$	13·572
370	630	$5\sqrt[3]{21}$	13·794
340	660	$5\sqrt[3]{22}$	14·01
310	690	$5\sqrt[3]{23}$	14·219
280	720	$5\sqrt[3]{24}$	14·422
250	750	$5\sqrt[3]{25}$	14·62
220	780	$5\sqrt[3]{26}$	14·812
190	810	$5\sqrt[3]{27}$	15·
160	840	$5\sqrt[3]{28}$	15·182
130	870	$5\sqrt[3]{29}$	15·3615
100	900	$5\sqrt[3]{30}$	15·535
70	930	$5\sqrt[3]{31}$	15·706
40	960	$5\sqrt[3]{32}$	15·854
10	990	$5\sqrt[3]{33}$	16·037

In answer to a question relative to American steam boats, he believed that the build of the river steamers was very peculiar: some of them had engines of 600 horses power on board, yet they drew only four feet of water, whereas a sea-going steamer with that power would draw at least 16 feet. As far as he could ascertain, the actual well-authenticated speed did not exceed 14½ geographical miles per hour through still water. The fuel consumed could not be ascertained, as it was chiefly wood, taken on board at the places of stoppage; there was a great consumption of steam at a very high pressure. Their machinery was not heavy, and was specially adapted to the vessels. Daily improvements were making in the form of vessels in England, and when high pressure steam and light engines were applied to vessels of a different form from those at present constructed, the speed must be increased. Some vessels were now building on the Thames of an extremely light construction, with tubular boilers, and the weight of the machinery would be only eleven cwt. per horse power.

February 16.—The PRESIDENT in the Chair.

The following were balloted for and elected: William Radford, Henry Alexander, John Gandell, William Bagnall, Thomas Bagnall, and James Bagnall, as Associates.

"*Practical Observations on the management of a Locomotive Engine.*" By CHARLES HUTTON GREGORY, Grad. Inst. C.E.

The working of a railway involves a number of practical details with which it is of great importance that the young engineer should make himself thoroughly acquainted. Of these, one of the most important is the management of a locomotive engine.

The communication consists of practical remarks on this subject from the author's individual experience; it is divided into three sections:—1st. The management of an engine in the Station. 2nd. On the Road. 3rd. In cases of accident.

Section 1st—contains instructions as to the state in which an engine should be kept in the station, and a detailed account of the examination to which it should be subjected previously to its starting with a train. The principal working parts are mentioned, with the particular attention due to each; and the proper supplies of oil, coke, and water, enumerated. The section concludes with a list of the articles necessary to be carried on the tender.

Section 2nd—enters fully into the leading points of engine driving. After attending to the precautions to be taken in starting, the author points out the proper position of the engineman, and the attention which he should give to the state of the rails, the safety of the train, and the working of the engine. Instructions are then given for the production and maintenance of a sufficiency of steam, by the judicious management of *water* and *fuel*. The proper height of the water in the boiler is described both under general and particular circumstances, and the times at which it should be supplied: with observations on priming, on the action of the pumps, and their irregularities.

This is followed by remarks on the proper manner of supplying coke, the extent and periods of that supply, the proper height of the coke in the fire box, &c.

Instructions are given for economizing and rendering the steam most efficient; the mode of treatment to be adopted in case of extraordinary deficiency or excess; rules for stopping and starting at the stations; general hints in case of the wheels slipping, and of the heating of the axles; precautionary measures to be adopted on curves, steep inclines, dangerous parts of the road, &c.; the care necessary for an engine at the end of each journey, and when finishing its work for the day.

Section 3rd—describes those accidents to which engines are most liable when running, and the steps to be taken under the circumstances: viz.—The bursting of a tube, the lagging of the boiler catching fire, the failing of the feed pumps, the breaking of an axle, of a spring, or of the connecting rod, the disconnexion of the piston, of the eccentrics, or any of the slide valve gear, the fracture of the strap of the slide valve, and the engine running off the rails.

"*Observations on the effect of wind on the suspension bridge over the Menai Strait, more especially with reference to the injuries which its roadways sustained during the storm of January* 1839." By W. A. PROVIS, M. Inst. C.E.

In the month of December 1825, when the original construction of the bridge was nearly completed, several severe gales occurred, and considerable motion was observed, both in the main chains and in the platform of the carriage ways. It appeared that the chains were not acted upon simultaneously, nor with equal intensity; it was believed, therefore, that if they were attached to each other, and retained in parallel plains, the total amount of movement would be diminished.

On the 30th of January, and on the 6th of February, 1826, some heavy gales again caused considerable motion of the chains and roadway, breaking several of the vertical suspending rods, and of the iron bearers of the platform.

These bearers were constructed of wrought iron bars, overlapping each other, and bolted together, with the ends of the suspending rods between them, for the purpose of giving stiffness to the structure. The flooring planks were bolted to the bearers, and notched to fit closely round the suspending rods, which were thereby held almost immoveably in the platform.

It was observed, that the character of the motion of the platform was not that of simple undulation, as had been anticipated, but the movement of the undulatory wave was oblique, both with respect to the lines of the bearers, and to the general direction of the bridge. It appeared, that when the summit of the wave was at a given point on the windward side, it was not collateral with it on the leeward side, but, in relation to the flow of the wave, considerably behind it, and forming a diagonal line of wave across the platform.

The tendency of this undulation was, therefore, to bend the bearers into a form produced by the oblique intersection of a vertical plane with the surface of the moving wave. The bearers were not calculated to resist a strain of this nature: they therefore were fractured generally through the eyes on each side of the centre foot-path, at the point of junction with the suspending rods, which being bent backward and forwards where they were held fast at the surface of the roadway, were in many instances wrenched asunder also.

The means adopted for repairing these injuries, and for preventing the recurrence of them, were, placing a stirrup, with a broad sole, beneath each of the fractured bearers, attaching it by an eye to the suspending rod, cutting away the planking for an inch around the rods, and at the same time bolting, transversely, to the underside of the roadway, an oak plank, fifteen feet long, between each two bearers, for the purpose of giving to the platform a greater degree of stiffness, combined with elasticity, than it previously possessed. The four lines of main chains were also connected by wrought iron bolts passing through the joint plates, and traversing hollow cast iron distance pieces, placed horizontally between the chains.

The effects of these alterations were so beneficial, that little or no injury occurred for nearly ten years. On the 23rd of January, 1836, a more than usually severe gale caused violent undulation of the platform, and broke several rods. There can be little doubt that ten years' constant friction, combined with the shrinking of the timber, had relaxed the stiffness of the platform, and permitted an increased degree of undulation. The gate-keeper described the extreme amount of rise and fall of the roadway in a heavy gale to be not less than sixteen feet; the greatest amount of motion being about half way between the pyramids and the centre of the bridge.

In consequence of the injuries sustained during this gale, the author and Mr. Rhodes were instructed to give in a report upon the state of the bridge, and on any repairs or additions which might appear desirable.

The result of the examination was satisfactory; the whole of the masonry, the main chains, their attachments to the rock, the rollers and iron work upon the pyramids, and all the principal parts of the bridge, were as perfect as when first constructed; it was, however, recommended, that "a greater degree of rigidity should be given to the roadways, so that they should not bend so easily under vertical pressure."

The bridge remained in the same state until the hurricane of the 6th and 7th of January, 1839; during the night of the 6th, all approach to the bridge was impracticable; the bridge-keeper, however, ascertained that the roadways were partially destroyed; and he in consequence traversed the strait in a boat in time to prevent the down mail from London driving on to the bridge.

When the day broke, it was found that the centre foot-path alone remained entire, while both the carriage ways were fractured in several places. The suspending rods appeared to have suffered the greatest amount of injury; out of the total number of 444, rather more than one-third were torn asunder; one piece, 175 feet long, of the N.E. carriage way, was hanging down and flapping in the wind; much of the parapet railing was broken away; the ties and distance pieces between the main chains were destroyed; the chains had resisted well in spite of the violent oscillation they had been subjected to, to such an extent, as to beat them together and strike the heads off bolts of three inches diameter.

Means were immediately adopted for restoring the roadways; and so rapidly was this effected, that in five days carriages and horses passed over, while foot passengers were not at any time prevented from crossing.

The account of the restoration of the bridge, communicated by Mr. Maude to the Institution, is then alluded to.

The substance of the report of the author to the Commissioners of Her Majesty's Woods is then given, and a review of the proposals made by Mr. Comms, Colonel Pasley, and others, relative to the restoration.

The opinion of Colonel Pasley, "that all the injuries which have occurred to the roadways of Suspension Bridges must have been caused by the violent action of the wind from below," is then examined, and reasons given for the author's dissent from that opinion.

The action of the wind upon the Conway and Hammersmith Bridges, is next examined; and from the amount of oscillation observed in all suspension bridges, the conclusion is arrived at, that winds act strongly and prejudicially on the fronts as well as on the horizontal surfaces of the platforms of suspension bridges, and that the effect of winds is modified and varied by the nature of the country, and the local circumstances connected with each individual bridge. Although differing in opinion with Colonel Pasley as to the general cause of injury to suspension bridges, the author agrees with him in the propriety of giving increased longitudinal rigidity to their platforms, to prevent or to restrict undulation. He advised its adoption in 1836, and applied his plan of stiffening by beams, in 1839. He preferred beams to trussed framing, on account of the facility with which the former could be increased in number, to obtain any requisite degree of stiffness, and because he feared that trussed frames could not always be kept firmly in their true vertical positions.

A drawing showing the injuries sustained by the platform during the hurricane of 1839, accompanied the communication.

Mr. Cowper was of opinion, that the real cause of injury to suspension bridges was the vibration of the chains and roadway. The whole suspended part, when acted upon by the wind, became in some measure a pendulum, and if the gusts of wind were to recur at measured intervals, according either with the vibration of the pendulum, or with any multiplies of it, such an amount of oscillation would ensue as must destroy the structure. He illustrated this proposition by a model with chains of different curves, and at the same time pointed out the efficiency of slight brace chains in checking the vibration.

Mr. Brunel agreed with Mr. Cowper in his opinion of the cause of injury to bridges, and with the propriety of applying brace chains, for preventing the vibration. He then alluded to the introduction of lateral braces in the bridge designed by Mr. Brunel, senior, for the Isle of Bourbon. He had been at the Menai Bridge during a severe storm, and had particularly noticed the vibration of the chains with the accompanying undulation of the platform. The force of the wind was not apparently from beneath; it appeared to act altogether laterally. The chains were too high above the roadway; their vibration commenced before the platform moved: the unequal lengths of the suspension rods then caused the undulating motion. His attention had latterly been much given to the subject on account of the Clifton Suspension Bridge, now erecting under his direction. The span would be seven hundred feet, and the height above the water about two hundred feet. He intended to apply the system of brace chains at a small angle to check vibration. To two fixed points in the face of one pyramid would be attached two chains, each describing a curve horizontally beneath the platform, touching respectively the opposite sides of the centre of the bridge, and thence extending to similar points on the other pyramid: there they were attached to two levers, the ends of which were connected with a counter balance of about four tons weight appended to each; these weights would hold the chains sufficiently extended to enable them to resist the lateral action of the strongest winds without their being so rigid as to endanger any part of the structure. By this contrivance the platform would be kept firm, which was the chief point to be attained.

In all suspension bridges the roadways had been made too flexible, and the slightest force was sufficient to cause vibration and undulation. The platform of the Clifton Bridge would have beneath it a complete system of trough-shaped triangular bracing, which would render it quite stiff. He was an advocate for bringing the main chains down to the platform, as at the Hammersmith Bridge, and for attaching the bearings to the chains at two points only; when they were suspended by four rods, it not unfrequently happened that the whole weight of a passing load was thrown upon the centre suspension rods, and the extremities of the bearers were lifted up and relieved from all pressure. The extent of the expansion and contraction of the chains was a point of importance. In the Menai Bridge the main chains on a summer day would be as much as sixteen inches longer than in a winter's night. At the Clifton Bridge the difference under similar circumstances would be about twenty inches. The whole expansion of the back chain beyond the pyramids must be thrown into the suspended part. He would prefer having only one chain on each side of the bridge, and that chain much stronger than is usually adopted, but in deference to public opinion he had put two; he believed that they rarely expanded equally, and hence an unequal distribution of the weight of the roadways upon the suspension rods occurred. A rigid platform would in some degree prevent this, but he had endeavoured to lessen the effects of unequal expansion by arranging a stirrup at the top of each suspending rod, so as to hold equally at all times upon both the chains, and thus cause each to sustain its proportion of the load.

Mr. Seaward had never seen the force of wind exerted at regular intervals, as Mr. Cowper had supposed; if the gusts were repeated at such intervals, no suspension bridge, nor any elevated shaft or chimney in masonry, could resist them.

Mr. Rendel believed that the errors committed in the construction of suspension bridges had principally arisen from engineers theorizing too much on the properties of the catenary curve, without attending sufficiently to the practical effects of wind in the peculiar localities in which the bridges were placed. He could not agree with Mr. Cowper in his view of the intermittent action of the wind, or the vibrating of the chains. Observation had led him to conclude that, in the positions in which suspension bridges were usually placed, the action of the wind was not uniform; for instance, it would act at the same moment on the upper side of one end of the roadway, and on the lower side at the other end. In this case, unless the platform possessed a certain degree of rigidity, undulation was induced and oscillation ensued. Braces and stays would not counteract this—nothing but a construction of platform, which made it in itself rigid by some mode of trussing, could withstand this kind of action. He agreed with Mr. Brunel in his idea of reducing the number of the suspending chains. At the Montrose Bridge, which was 432 feet span, he had endeavoured to avoid all complexity of contrivances by adopting a complete system of vertical diagonal trussing, which was ten feet deep—five feet above, and five feet below the platform—so as to insure rigidity, and to produce that solidity which was essential for preventing undulation and oscillation.

Mr. Cowper reverted to the motion which he had found to be so easily produced by repeatedly exerting a small force at measured intervals against the main chains of the Hammersmith Bridge. He conceived that if the chain oscillated, the roadway must oscillate also.

Mr. Rendel contended that the motion produced by the impulses communicated by Mr. Cowper to the chain resolved itself into undulation, and not oscillation. He could not understand the advantages of the trussing adopted at the Hammersmith Bridge: it appeared to him that its tendency was, on the passage of a heavy weight, to relieve four out of five of the suspending rods from their due proportion of the load, and to throw it upon the fifth rod. His object in the construction of the framing of such platforms had always been to spread the load quite equally, and rendering it rigid by means of vertical trussed framing, to prevent the undulation which was the primary cause of oscillation. He would distinguish clearly between the two motions, and say, that undulation was a motion in the direct line of the platform, and that oscillation was a motion at right angles with it. Vibration was identical with undulatory action.

Mr. Donkin conceived that a good system of trussed framing could alone prevent undulation or oscillation; if the framing were placed vertically, its tendency would be to prevent undulation; if placed horizontally, to prevent oscillation: now, as Mr. Rendel had given it as his opinion, that the latter action resulted from the former, the system of trussing adopted by him at the Montrose Bridge would appear calculated to obtain the desired end. A slight exertion of force would produce a perceptible undulation, and a certain degree of vibration would result from the natural elasticity of the materials.

Mr. Seaward remarked, that the degree of oscillation would appear to depend in some measure upon the distance at which the platform was suspended beneath the chains, and upon the distance between the points of suspension of the main chains; if the platform were rigidly held at the extremities, the motion would be vibratory, and not amounting to undulation.

The railway tickets on the Manchester and Leeds line, invented by Mr. Edmondson, are printed by a machine which gives each a progressive number, and arranges them in order. Two boys lately printed 10,000 tickets in four hours.

THE PRESIDENT'S CONVERSAZIONE.

The general conversazioné of Mr. Walker, the President of the Institution of Civil Engineers, took place on Wednesday evening, 12th ult., and was distinguished by the same features of interest which always render this one of the most remarkable reunions of the season. The suite of rooms was embellished by works of art of almost every class, extending from the production of the golden age of art, down to those of the aspirants of the present day. Amongst other objects of this description, which were scattered in profusion through the spacious though crowded area, we particularly noticed several admirable busts by Park, Belines, and Smith, together with one of the host himself, modelled in clay by Mr. J. E. Jones, an amateur whose talents, if he had not already chosen a profession in life, would certainly entitle him to shine in this department of art. The portfolios of drawings by Varley, Hering, Tomkins, Fripp, and Kendrick, and the paintings by Scanlan and John Wood, excited great attention, and elicited corresponding praise. A new etching by Thomas Landseer, the first proof of his brother Edwin's picture of Count d'Orsay's dog "laying down the law," was displayed amongst these objects of art. Nor ought the unrivalled vases and bronze figures, the work of the eccentric Florentine artist of the 15th century, of Clodion and others of later date, to be passed over in silence. There were also some of Goddard's fine Daguerréotypes, some electrotypes, as also some specimens of Cheverton's beautiful mechanical sculpture. The most striking of the useful novelties were samples of coloured glass from Mr. Apsley Pellatt's manufactory, some ornamented slabs, &c., of slate from Magnus's Pimlico works. Atkinson's patent ornamental wood mouldings, which are equal to carved work; Pole's new hygrometer. The principal feature, however, of Mr. Walker's soirée was the exhibition of models of machines, &c., which were, throughout the evening, the chief focus of attraction. It is impossible, within the limits of an ordinary notice, to afford any thing like an adequate epitome of the various ingenious and highly useful, as well as valuable, novelties which attracted the attention of the guests on all sides. The model of the lighthouse erected on the Maplin sands at the mouth of the Thames, by Mr. Walker himself, obtained very great attention, a description of which appeared in the last number of the Journal. Mr. Hicks' radial drilling machine, his compound hydraulic press, and new governor, &c. Messrs. Seawards' beautiful models of marine steam-engines, the slide-valves, the disconnecting apparatus for paddle-wheels, and the brine detector, Barnes' paddle-wheel, and the model of the Castor steamer. Mr. Dent's electric and central percussive clocks, Mr. Gossage's disc steam engine, Messrs. Whitworth's (of Manchester) street cleansing machine, cutting tools, &c., Messrs. Ransome & May's railway chairs, Dr. Schaffhaeutl's new universal photometer, a sectional drawing of the Thames Tunnel by Sir Isambart Brunel, and a vast assemblage of other beautiful adaptations of the chemical, electrical, and mechanical branches of science to the purposes of utility and ornament, excited the admiration and occupied the untired attention of the stream of visitors for several successive hours. The conversazioné was attended by most of the distinguished amateurs and professors of science and art, and notwithstanding the eventful debate in the House of Commons, which was proceeding at the same time, and which occupied all the peers and members of Parliament, and the Literary Fund dinner, which detained many of the usual visitors, the numbers who availed themselves of this opportunity of testifying their love of science and esteem for the distinguished President, was very great.

Among the company we noticed, besides the council and a large number of the members of the Institution, the chief members of almost all the scientific societies of the metropolis:—The Marquis of Chandos, Lord Henneker, Admiral Adam, Barons Schleinitz and Bulow, Colonels Pasley, Maclean, Lieut. Colonels Blanshard, R.E., Hutchinson, Major Anderson, Sirs J. J. Guest, M.P., Frederick Pollock, M.P., Wm. Symons, John M'Neil, Isambart Brunel, George Murray, Walter Riddell, Henry Parnell, M.P. Edward Knatchbull, M.P., Chas. Price, Harry Verney, M.P., John Scott Lillie, Chevalier Beukhausen, Captains Laird, Ivanetskey, Locke, Willis, Scanlan, Pringle, R. Wellbank, L. Price, Kincaid, Smith, G. Smith, R.N., Evans, R.N., R. Drew, Drs. Paris, Schaffhaeutl, Elliot, Field, Pollock, Arnott, Walker, Billing, Roget, Bowring, Rigbey, Reid, Professor Willis, Messrs. E. R. Rice, M.P., Pryme, M.P. F. Hodgson, M.P., Ormsby Gore, M.P., G. F. Young, M.P., Emerson Tennent, M.P., Mr. Justice Haggerman, of Canada, Messrs. T. Landseer, F. P. Stephanoff, Belnes, Tomkins, J. Varley, E. H. Bailey, F. Stone, G. Rennie, Fripp, Rivers, Jun., Hakewell, R. Scanlan, Sargey, A. Cunningham, Oliver, Page, S. Howell, W. Boxall, C. Landseer, Macready, Barry, Sydney Smirke, Tite, Donaldson, Hopper, and Poynter.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Monday, May 3.

The annual general meeting of the Institute was held for the purpose of electing the council and officers for the ensuing year. Earl de Grey in the chair.

The report of the council and the annual balance were presented, and exhibited a highly favourable view of the progress of the Society.

Monday, May 17.

A paper was read by Mr. G. F. Richardson, of the British Museum, on the subject of geology as connected with architecture. After a prefatory sketch of the general stratification of rocks, Mr. Richardson adverted more especially to the stratum and quality of those in most general use as building materials. The lecture was illustrated by the exhibition of various objects connected with the subject in the oxy-hydrogen microscope.

Messrs. Pontifex and Co. exhibited a new construction of a self-acting water closet.

ROME AT THE SURREY ZOOLOGICAL GARDENS.

The mimic volcanic flames of Hecla, Etna, and Vesuvius, are now extinct at the Surrey Zoological Gardens, and we have another giant wonder from the burning climes of the South. When we heard that Rome was to be portrayed to the gaze of the successor of its greatness, we were naturally anxious to ascertain whether it had a fitting representative; Mr. Cross has succeeded very well in housing lions and tigers and elephants, but where he was to pitch down the Eternal City we could not readily conceive. He has, however, by placing it near the lake found means to appropriate to it a space of five acres, a space large enough to hold a modern town, and to do justice to the object of this representation. We have here a pictorial model, covering a surface of more than a quarter of a million of square feet, and presenting, as has been well stated, "a stupendous panoramic view, and the largest picture or model ever produced." The lake now stands for the Tiber, and across it we have the bridge of St. Angelo, with its statues of angels on the walls. Beyond are seen on the left the Tordinona Theatre, the Palazzo Tortonia, and other well known edifices. On the right the Mole of Hadrian, now the Castle of St. Angelo, raising its giant bulk. Farther behind, rising over every thing, is St. Peter's, upwards of a hundred feet in height, and appearing as magnificently as its great original. The façades of the Vatican, the Papal Palace, the Ospitale di Spirito Santo, and many other structures well known to fame are strikingly represented. To be properly appreciated this exhibition must be seen; the apparent solidity and verisimility of the structures, the extreme range of distant view, are features which tend to impress us with a sense of the reality of the objects before us. The painting is good, free from glare and exaggeration, and subdued so as to give that sobriety and real life, which augments the impression on the spectator; we think however that the effect might have been increased by a few figures of men and animals being appropriately introduced. The artist is Mr. Danson, and in naming him we do quite enough to show that full justice has been done to the subject, for his reputation in this department of art is a guarantee of the extent of his exertions. We may indeed assure our friends that those among them well acquainted with the Eternal City will be gratified in renewing their recollections of it, and those who have the pilgrimage yet to make, cannot have a better introduction than by a visit to this, its prototype.

NEW INVENTIONS AND IMPROVEMENTS.

IMPROVEMENTS IN STEAM ENGINES.

George Henry Fourdrinier and Edward Newman Fourdrinier, of Hanley, Stafford, paper makers, for certain improvements in steam engines for actuating machinery, and in apparatus for propelling ships and other vessels on water.—Rolls Chapel Office, March 17, 1841.—These improvements are, as the title explains, divided into two parts; the improvements in steam engines consist in applying and working two pistons in one cylinder, which are simultaneously actuated by the expansive force of the same volume of steam. A long cylinder is supported vertically on pivots, in the middle of which it vibrates; two pistons are attached to piston rods which pass out through stuffing boxes at either end of the cylinder. On steam being admitted through suitable slide valves to the middle of the cylinder, the two pistons are forced apart towards the opposite ends of the cylinder, the valves are then shifted, and the steam admitted at the two ends of the cylinder, which drives the piston back again to the centre, the spent steam passing off to a condenser or into the atmosphere, and so on continually. The lower piston rod is attached to a crank in the middle of the shaft, while the upper piston rod carries a cross head from which connecting rods pass down to two cranks placed on the same shaft, but opposite to the former, so that as the one is descending the other is ascending, in conformity with the opposite motion of the pistons. In another arrangement, the cylinder is divided into two parts by a partition in the middle, and the pistons do not expand simultaneously as in the former case, but the one piston begins to move when the other is at the quarter stroke, the valves being so adjusted as to effect this movement; for the purpose of overcoming the dead points, when one piston is at the dead point the other is exerting its full force. The apparatus for propelling ships and other vessels consists of certain arrangements of mechanism by which a volume of air may be forced against the water at the bottom of the vessel, in the direc-

tion of its stern, for the purpose of impelling the vessel in an opposite direction. The air being compressed by an air pump, "to the same density as the water under the ship's bottom," is admitted through a valve into a tube, down which it flows into the water. The bottom of the vessel has two guards of wood or other material, parallel to its keel; as the air enters the water beneath the vessel it is guided by the guards, which prevent it from escaping at the sides, and by its pressure against the water, in the direction of the stern, impels the vessel head foremost. The direction of the air, backward or forward, is regulated by a tumbling valve, worked by a quadrant rack or sector, and an endless screw; by altering the position of this valve the direction of the air, and, consequently of the vessel, may be reversed at pleasure. When the vessel rolls about in a heavy sea, it is considered desirable to force the air under the most depressed side of the vessel only; to effect which the air plugs are connected to a pendulum which opens the valves on the one side or the other, according to the position of the vessel. In another arrangement for reversing the motion of the vessel, two sets of sliding tubes descend from the air chambers, opening fore and aft; if the vessel is to be propelled head first, the two hinder tubes are depressed and the air passes off towards the stern; but if the vessel is to be backed astern, the foremost tubes are depressed and the air projected towards the head of the vessel. The claim is—1. To the application of two pistons working in one cylinder, as shown.—2. For propelling vessels, by forcing a volume of air against the water beneath the bottom of the vessel, in the manner shown and described.—*Mechanics' Magazine.*

MOVEABLE OBSERVATORY AND SCAFFOLD.

Alexander Horatio Simpson, of New Palace-yard, Westminster, Middlesex, gentleman, for a machine or apparatus to be used as a moveable observatory or telegraph, and as a moveable platform in erecting, repairing, painting, or cleaning the interior or exterior of buildings, and also as a fire escape. Enrolled May 5.—Claim first. The use of a shaft or spar as herein described, with a gallery or platform suspended or attached so as to be capable of being raised or lowered on the shaft by a power, either manual or otherwise, exerted within the platform.

This machine consists of a shaft or spar, mounted in a step, in which it is capable of turning (the step being fixed to a foot or pediment), and supported laterally by stays, jointed at their upper ends to a collar, which slides on the shaft, but is retained in any required position by a pin. The lower ends of the stays fit into holes in the foot or pediment, so as to admit of the stays altering their position or angle, in relation to the shaft, and thereby supporting it in different positions. The shaft is constructed of wrought iron plates, rivetted together, and one side of it is formed by a rack sunk flush with the surface of the shaft, which rack may be of cast iron; but one of the lantern form is preferable, the teeth of which is formed by long bolts or rivets, running across in the same position as the teeth of the cast iron rack. On the shaft is a sliding frame, to which is attached a gallery for the reception of workmen, tools, &c., and this sliding frame is fitted with a pinion, whch working in the rack of the shaft raises or lowers the gallery or platform, according to the direction in which it is turned.

This machine may be used as a telegraph, by having the usual apparatus attached to the top of the shaft, or it may be used as a moveable observatory.

Claim second.—The use of a horizontal suspension rail, supported by shafts or spars, with a platform or gallery suspended therefrom, capable of receiving motion from within the gallery.

Claim third.—The giving motion to the gallery or platform, by the application of a power, either manual or otherwise, from a point not within the gallery or platform.

This part of the invention is an improved construction of scaffolding, and consists of two shafts, placed one on each side of the front of the building, similar to that before described, but without the rack and platform with its appendages. On the top of these shafts is fitted a cross rail, on which is mounted a carriage running on flanged wheels, and to these wheels are fixed two "gallows," suspending a light ladder by a pin or bolt. On the centre of this bolt is a roller or pulley, over which a rope passes, one end of it being fastened to a gallery similar to that before mentioned, and sliding on the ladder, and the other end to a counterpoise weight. On the foot of the ladder there is another roller, that runs on a cross bar, similar to the bar at the top, but which roller supports none of the weight of the ladder, as it rolls nearly horizontally and against the side of the bar, being provided for the purpose of permitting the ladder to travel easily to and fro.

In order to bring the gallery to bear on any portion of the surface of the building that the workman may require, four ropes are provided; two of these are fastened to the bottom of the shafts, and passing over two live pulleys at the foot of the ladder, proceed up to the gallery; the other two are fastened to the top of the shafts, and pass over two live pulleys, on the same axletrees as the wheels of the carriage before mentioned, into the gallery.

Now if the person in the gallery pulls the two top ropes, he raises the gallery, or if he pulls the two bottom ropes, he lowers it; if he pulls either of the two side ropes, namely, those attached to the same shaft, leaving the other two side ropes loose, the gallery and ladder will move horizontally in a lateral direction.—*Ibid.*

DRIVING BELTS AND STRAPS.

James Heywood Whitehead, of the Royal George Mills, near Saddleworth, Yorkshire, manufacturer, for improvements in the manufacture of woollen belts, bands, and driving straps. Enrolled May 2.—This invention consists in applying a composition to a woollen belt to give it firmness and adhesiveness, as a substitute for leather for driving machinery.

The composition consists of linseed oil and resin mixed together, in the proportion of three pounds of linseed oil to two pounds of resin; but these proportions may be varied a little to suit circumstances. The oil is first boiled, and the resin in fine powder added to it while it is in the boiling state, being well stirred till they are thoroughly mixed together.

The belt or strap is passed through the mixture and between two rollers, which are weighted sufficiently to make the composition even, so that it will not run out of the cloth when hung up. The cloth is then well stretched in length and dried, after which it is ready for use.—*Inventors' Advocate.*

RAILWAY CARRIAGE.

James Boydell, jun., of Cheltenham, ironmaster, for improvements in working railway and other carriages, in order to stop them, and also to prevent their running off the rails. Enrolled May 2.—Claim first. The mode of applying apparatus acting by lever pressure on rails, as a means of stopping carriages, as herein described.

Beneath the lower part of the railway carriages a projection is affixed, carrying the axis of a lever, the lower end of which lever is enlarged and embraces the rail, the part which comes against the rail being lined with wood, to enable it to offer greater friction. This part of the lever is, by means of another lever, and connecting links, brought in contact with the rail, whenever it is desired to stop the train.

Claim second.—The mode of applying bars to prevent carriages running off the rails of railways.

Beneath each carriage are two bars, which extend across from opposite corners of the framing of the same, crossing each other beneath the centre of the framing, and from which centre they are suspended by means of a pin passing through a slot formed in the centre of each bar. The ends of the bars are connected by pins to the ends of the bars of the carriages before and behind them, thus forming a continuous bar, which will in most cases prevent the carriages from getting off the rails, and in case one of the carriages should run off the rails will prevent it from running at any considerable angle to the same. The slots in the bars have sufficient play to permit the train to move over curves easily.—*Ibid.*

MR. GRANT'S PATENT FUEL FOR STEAM BOATS.

We learn with great satisfaction, that this important invention is at last to be brought into general use. The Admiralty, after a long series of experiments made under their directions, by Mr. Grant, and followed up by frequent trials of his fuel in her Majesty's steam vessels, instructed him some time ago to take out a patent, chiefly, we suppose, to secure themselves and the public against the interference of any pretenders to the invention.—This point being settled, it became the wish, as it was the obvious duty of government, to extend the benefits of Mr. Grant's labours to the country at large.

Numerous applications having been made to Mr. Grant, by the various steam vessel companies, for permission to make use of his patent, the Admiralty, in a spirit of enlarged policy, have, as we understand, directed that gentleman to refer all persons to them who desire licenses to manufacture his fuel—and we have no doubt that their Lordships sanction will be given accordingly. But, we trust, the terms will be so moderate as to render it the interest of those extensive companies, whose vessels now cover so many seas, to employ this new agent for the production of their steam power.

A word or two on the nature and properties, as well as the practical advantages of Mr. Grant's fuel, will probably not be unacceptable to our readers generally, and may prove useful to such persons as are engaged in steam boat enterprises on the large scale.

It is not our purpose, nor would it be proper, to describe minutely Mr. Grant's process—it will be enough to say, that his fuel is made of coal-dust and other ingredients, mixed together, in certain definite proportions, and then fashioned, by a peculiar process, into the shape and size of common bricks. The advantages of Mr. Grant's patent fuel over even the best coal may be stated to consist—first, in its superior efficacy in generating steam, which may be stated in this way—200 tons of this fuel, will perform the same work as 300 tons of coal, such as is generally used;—secondly, it occupies less space, that is to say, 500 tons of it may be stowed in an area which will contain only 400 tons of coal;—thirdly, it is used with much greater ease by the stokers or firemen than coal is, and it creates little or no dirt, and no dust—considerations of some importance when the delicate machinery of a steam engine is considered;—fourthly, it produces a very small proportion of clinkers, and thus is far less liable to choke and destroy the furnace

bars and boilers, than coal is;—fifthly, the ignition is so complete, that comparatively little smoke, and only a small quantity of ashes are produced by it;—sixthly, the cost of the quantity of Mr. Grant's fuel required to generate in a given time a given amount of steam, is so much less than that of the quantity of coal which would be consumed in effecting the same purpose, that, even if the advantages of stowage, cleanliness, and facility of handling, were not to be taken into the account, the patent fuel would still recommend itself to the attention of all steam boat proprietors.—*Hampshire Telegraph.*

[The first part of this statement appears to us rather extraordinary that the Lords of the Admiralty should interfere with the working of a patent in any kind of way, and that parties requiring licenses are to be referred to them; surely there must be some mistake in the statement.—Editor C. E. and A. Journal.]

APPLICATION OF ELECTRO-MAGNETISM TO MACHINERY.

(From the Leipsic Allgemeine Zeitung.)

Leipsic, April 17.

The meeting of our Polytechnic Society was rendered peculiarly interesting by a lecture given by Herr Störer on his experiments in the application of electro-magnetism as a motive power. Herr Störer commenced his experiments several years ago, before Wagner's invention, and has proceeded independent of it. By merely following up and carrying out the ideas of Jacobi, to whom the first merit of the discovery is due, he has succeeded in constructing a small machine, the power of which is as yet limited to the raising of only a moderate weight and putting a turning lathe in motion, but which is nevertheless sufficient to render perfectly evident the whole mechanism of the important invention, and which, as the constructor observed, needs only to be enlarged to produce more practical effects.

The principle of electro-galvanic movement has its source, as is well known in the law of reciprocal attraction and repulsion of two iron bars, surrounded by a galvanic current, alternating with positive and negative electricity, and thereby magnetized. Herr Störer's machine consists at present of only two concentric circles of spiral iron bars, surrounded by conducting wires for the reception of the electric current. Each circle contains 12 single bars, placed at the distance of from 2½ to 3 inches from each other, the bars of the outer circle being about half an inch separated from those of the inner. The outer circle is fixed; the inner forms the periphery of a moveable disc, swinging wheel, or pinion. This mechanism is brought into connexion by two conducting wires with a galvanic battery, in such a manner that in the first place the bars of the one circle with positive electricity surround those of the other with negative electricity; then suddenly, by an arrangement in the conducting apparatus, the current is changed, and thereby electricity of the like name is produced in both circles. The consequence of this is, that the opposite bars, in consequence of the different magnetic power communicated to them, first attract each other, then instantly becoming, by the inversion of their poles, similar magnets with equal force, repel each other. By this regularly repeated alternation of attraction and repulsion, each bar of the internal moveable circle is in succession drawn towards all the bars of the external fixed circle, and then driven as it were back on the next, whereby the whole disc is brought into a state of uniform motion.

The inventor makes a very moderate estimate of the cost of the machine. The expense consists chiefly in the wear of the zinc in the galvanic battery, by the action of the acid; but as to the outlay for this article, it will be almost entirely counterbalanced by the precipitate which in consequence of the operation is formed in the acid, and which yields a somewhat valuable chemical product. With regard to the power of the machine, and the possibility of reinforcing it so as to produce greater practical effects, Herr Störer submits the following considerations:—The present machine, though only double the size of the one he first constructed, which had only six pair of bars, acts with a sixfold increase of force. Each galvanic element consists of a copper cylinder, a zinc cylinder within it, and a chemical mixture by which they are connected. Now, as respects the effect of the number of elements employed, Herr Störer makes the following observations, the accuracy of which he has proved by experiments:—"In the connexion with a single element the machine raises, with moderate velocity, 3 lb.; with two elements, 13 lb.; with three, 25 lb.; with four, 40 lb. This is approximatively an ascending gradation of power in the ratio of 1, 4, 8, 12, whence it certainly would appear that the force might not be found to augment exactly in the relation of a progressive increase of the elements." According to Herr Störer's calculations, the connexion of a battery of 50 elements, with a machine in cubical contents 26 times greater than the one exhibited, would produce an effect equivalent to 50 horse power.

Still, however, after all these data and calculations, there remain several doubts as to the practicability of the application of this invention to machinery on an extensive scale. On the other hand, the results obtained by the experiments hitherto made are of sufficient importance to encourage a spirited prosecution of the discovery, which is in itself so ingenious, that it ought to be joyfully hailed by all who take an interest in the progress of civilization, as a new triumph of the human mind over inanimate matter. At all events, we Germans have just reason to be proud of an invention the first idea of which came from a German, and all the improvements yet made in which are the offspring of German intellect and German perseverance.

CONTINENTAL MODE OF BORING, BY APPLICATION OF THE ROPE.

When I was lately residing on the Continent, I occasionally observed notices in the foreign papers of this mode of boring, with flattering accounts of its advantages. I was anxious to obtain information about it, but I did not succeed in doing so until I perused the official report of M. Jobard on the Paris exhibition of 1840 His account is, indeed, in some degree, defective, as it does not furnish diagrams of the instruments; nevertheless, it gives a general view of the method, which seems to be attended with the surprising benefit, that the expense of the bore per fathom does not increase in any considerable degree with the depth of the bore. Having both observed and experienced the cost, danger, and tardiness of the bore with boring rods, when a great depth is reached, I have found M. Jobard's report interesting and instructive; and, therefore, as the subject may be new to some of your readers, I venture to send you the substance of it, in case you think it worth insertion in your valuable Journal.

There are in all three instruments, or tools, used in the method alluded to—the *mouton*, *emporte piece*, and *alezoir*. The *mouton* is a cylinder of cast-iron, of about eight inches in diameter and thirty-nine inches in height—weight from one to three cwt. This cylinder has exterior flutings, 4-10ths of an inch in depth and 6-5ths of an inch in breadth; the upper part contains an empty cone, whose base is reversed, which gives it the form of a bucket with thick sides. There are two handles to the cylinder, one above the other—if the first should break, the second retains the rope. The lower part of the tool is prepared to receive a number of steel chisels, which are fixed by a transversal key. The tool should be composed of as few pieces as possible, for, however well they are fixed, the percussion tends to detach them, and to leave them at the bottom of the hole. The best way of procuring good moutons of percussion, for hard strata, is to make them all of one piece of case-hardened cast iron, with handles of malleable iron hooked into the cast iron. These handles should be high up, in order to facilitate the extraction of the powdered stone, which accumulates in the empty part of the mouton. The head, or top, of the tool should exhibit a number of pyramidal points, projecting about an inch, diamond-pointed, the better to cut into the stone. The case-hardening gives them the hardness of tempered steel, and makes them last a long time. A mouton of three cwt. costs only 50f. (2l.); when it is worn, the old metal serves for the casting of others. The rock is cut daily to the depth of at least 39 inches. The rope is worked by a long plank placed obliquely, the upper end being about 12 or 15 feet above the hole. The mouton is suspended about 15 or 20 inches from the bottom of the hole. Motion is given to this plank by the hands or the feet, or by several men pulling together by ropes attached to the plank. There are also several other ways of working the main rope.

In boring with boring rods, four or five hours are required to draw them and lower them again; but all this is done (when the bore by means of the rope is used) in eight or ten minutes. In this latter, then, the progress of the work is always nearly the same—at 3000 as at 100 feet. The same number of men, too, is sufficient to work it, let the depth be what it may. What takes place, is as follows:—The mouton, falling 25 or 30 times a minute, from a height of two or three feet, readily breaks and pounds the rock. The dust or powder which results from this would soon deaden the blow, if there were no water in the bore hole, but there is almost always some—if not, it should be thrown in. The water and the dust form a magma—a mortar or mud, which spouts up by the flutings carved around the mouton. This mud falls back necessarily on the head of the mouton, and, as this is hollow, the mud enters a little at every blow. This powdered stone heaps up in the interior of the cone, by the work, to such a degree, that force is often necessary to get out the stony sugar-loaf which is there concreted after some hours striking. The contents of the instrument are known; it is sufficient, then, to put a mark on the rope, at such a height, to know that, when the rope has lowered a certain distance, a certain number of inches of matter have passed from below to above the tool. Before retiring the mouton it should be left at rest one or two minutes, to allow the heavier particles of the mud, which are in suspension at the bottom of the bore hole, to deposit themselves in the bucket—but not longer, for so it might get it incrusted.

The mouton alone suffices to the Chinese to bore to the depth of 1800 feet. Their strata are hard and solid enough not to require tubing, but it would not do for clay, sand, or pebbles—in that case the *emporte piece* is requisite. It is a cylinder, which has at its base two valves, turning on a hinge in the diameter, in the form of the wings of a butterfly. This cylinder is lowered to the bottom of the hole, and is caused to penetrate the strata by the intermediate percussion of a mouton, of the weight of 65 lbs., which is made on purpose for the emporte pièce. The mouton, having an aperture in the centre, slides for some feet along a metallic rod, which is fixed to the emporte pièce. When the mouton is raised, it gets as far as a bolt, which stops it; it then falls on the emporte pièce, which latter sinks at every blow, and its valves open to let the mud pass. When it is thought the instrument has sunk far enough, it is drawn up, and it arrives with a cake of mud, &c.; but care should be taken not to allow it to sink too far into plastic clay—it might then be difficult to draw it out. For strata which require tubing, there is, besides, the *alezoir*. The following is the simple artifice employed to enlarge the bore hole when it is tubed (or, to resolve the problem, to form with an instrument, which is obliged to pass through a tube, a hole larger than the exterior of this tube):—The tube is supported by straps, at about two lengths of the mouton from the bottom of the hole. The mouton used in this case has a square, and not a round, handle at its upper part. It is easily conceived that, if the rope is fastened to the middle point of the handle, which corresponds to the centre of gravity and to the centre of figure, the mouton would strike straight, and would only form a hole equal to the diameter of the instrument or the interior diameter of the tube; but if the point to which the rope is fastened is borne away one or two inches from the middle point of the handle, the centre of gravity becomes displaced, and the lower part of the mouton inclines to the right or left—a position which causes it to rub and

wear away the sides of the hole with its crown, at the same time that it attacks the bottom with its steel teeth. When this instrument, which is slightly conical, is drawn up, it sets itself straight again, and rises up in the tube, exercising a feeble friction on the sides of the tube. This mouton, like that for the strata, which require no tubing, has a receptacle for the mud. In using either mouton, a movement of torsion must be impressed on the rope. This is effected by fixing the rope into the extremity of a wooden bar, of about two feet long, which gives a workman sufficient leverage to turn or twist the cord a little at every blow, or to regulate its untwisting. In this way the hole cannot fail to be circular and quite perpendicular. By this means, at the well of the Military School, they have got down a single tube of iron plates, rivetted, of 11 inches diameter, to the depth of 650 feet. The tube moves freely—one man can turn it round. The wire rope would answer well for this mode of boring. The moutons are not difficult to make; a village blacksmith may construct or repair them; he should fasten the steel chisels in such a way that they can be occasionally taken out to be sharpened. The method of boring by means of the rope is much used in Saxony.—*Mining Journal.*

BUILDERS' BENEVOLENT INSTITUTION.

In another part of the Journal, it will be seen that we have requested the attention of our engineering readers to the merits of an institution for the relief of engineering workmen, and now we have to make a similar request of our architectural readers. They will see that a meeting has been held for the purpose of establishing a Builder's Benevolent Institution, and we hope that they will readily lend their aid for the promotion of an object so laudable. We need scarcely say that it has our very best wishes for its success. The meeting to establish an asylum and pension fund, and for the general relief of the decayed and suffering members of the builders' trade, was held on the 24th ult. at the Crown and Anchor, Strand; Mr. Burnard, surveyor, in the chair. The advertisement convening the meeting having been read by Mr. Barber, the secretary, the chairman, in a brief but neat speech, detailed the objects of the institution, remarking that there were no less than 20 trades connected with the building business—as architects, surveyors, painters, engineers, bricklayers, slaters, sawyers, &c.; yet the builders had neither an institution like that which they were assembled to establish, nor an asylum, nor any benefit society to apply to in poverty or old age. The objects for which the institution was about to be formed were highly praiseworthy and beneficial, and he was glad to say, that the committee had been promised support in all cases in which they had applied, and he hoped soon to see the builder's asylum rise second to none even in this great metropolis. The secretary then read letters from the Marquis of Westminster, the Earl of Cadogan, Sir R. Peel, Mr. Barry, the architect, Mr. Philip Hardwicke, Mr. D. Burton, Mr. Thomas Cubitt, Alderman John Johnson, and many other gentlemen of standing and respectability, all concurring in the objects of the meeting. The report of the committee was then read. It contained a well-written narrative of the steps the committee had taken, the reception they had met with from those to whom applications had been made to assist them in their praiseworthy endeavours to found the Builders' Asylum, and concluded with a very flattering account of the success that had attended their efforts. The report being adopted, a series of resolutions was put and passed in the usual manner. A subscription was entered into before the members left the room, for carrying out the purposes of the institution, and was liberally responded to.

REPAIRING AND MAINTAINING OF PUBLIC WORKS.

The following important judgment in the case of *The Queen* v. *The Bristol Dock Company*, was delivered in the Court of Queen's Bench, Westminster May 25, at the sittings *in Banco*. The defendants in this case have been incorporated under the 43rd George III., c. 140, for the purpose of making, completing, and maintaining a new watercourse in connexion with the river Avon, and this purpose they had effected. Some part of the works of the new watercourse, however, became subsequently out of repair; and upon a former occasion a rule had been obtained calling upon them to show cause why a *mandamus* should not issue commanding them to repair that portion of the banks of the new watercourse which had become dilapidated, and which, in its present condition, caused an obstruction to the navigation. The rule was made absolute, and the writ having issued, the defendants returned that they were not bound, according to the general law of the land, or to the provisions of the particular act above mentioned, to repair the portions of the watercourse which formed the subject of the discussion.

Lord Denman now delivered the judgment of the court upon the case, which was, that in the circumstances of the transaction the defendants were bound to make the repairs which the writ commanded them to make. His lordship laid it down in the course of the judgment, that where parties obtained an act of parliament for the construction and maintenance of great public works, they were bound in law to fulfil all the incidental duties of which the performance was necessary for the discharge of their duties in respect to the principal subject. His lordship also stated, that if public bodies omitted the performance of such incidental duties, they would be compelled to do so by the direct interposition of this court. It had been argued upon the part of the defendants, that as the injury consequent upon their neglect to repair the bank was of a public nature, and one for which they were liable to an indictment, that particular proceeding ought to be adopted, and there was therefore no necessity and no ground for a *mandamus*. The court, however, dissented from this position, and declared that where a company were obliged to do a particular work, and where the consequence of their not doing it was to produce a public nuisance, that circumstance, although it rendered them liable to an indictment, did not release them from the necessity of a specific performance of their duty upon the subject, in obedience to the mandate of this court. In this case, therefore, a peremptory *mandamus* would be awarded.

S. L. IN REPLY TO CANDIDUS.

Sir—I am surprised that Candidus should have thought it necessary to combat an imaginary assertion by such very trite observations. But he is evidently affected with the usual mania of critics, viz., that of putting an arbitrary interpretation on the object of their criticism, and then attacking the author for entertaining an idea which is but the fruit of their own fertile imagination. For instance, where Candidus can find that I have said any thing to discourage the roughest handling of public men, if kept within the bounds of truth and reason, I cannot possibly conceive; nor can I find any thing which can justify his supposition, that I may probably greatly prefer Buckingham Palace to Windsor Castle, &c.

With regard to mullioned windows, I confess I cannot see the propriety of substituting any thing which would have the effect of an open screen, for a glazed window; and though we may make infinitely greater departure from the genius of Grecian architecture. Candidus may remember that pure Grecian was not the style advocated; the architect must go to Rome and Pompeii for his materials, as well as to Athens.

When I spoke of the difficulty of persuading persons to adopt Gothic, who are not possessed of antiquarian taste, I said nothing about "soi-disant" or "hole-in-the-wall" Gothic; every one is aware of the great facility afforded for the adoption of that style—I mean by Gothic such as would do credit to an architect; but most persons find this to interfere too much with their comfort for them to "allow it to be properly treated."

With respect to what Candidus is pleased to call my very bold assertion, I would beg him to observe that I stated that the *object* of the architect, when he employed the Grecian or Roman style, was invention, not that originality was always the *result* of his efforts. I shall, however, be glad if he will refer me to a modern Gothic building possessing half as much originality as St. Stephens, Walbrook, or the spire of Bow church.

I quite agree with Candidus that it is well to avoid "squeamishness and affected delicacy in architectural criticism," but it would also be well if he would pay some respect to decency in the choice of his expressions, and not make use of those of which a gentleman would be ashamed, and which diminish, rather than increase, the force of his observations.

I remain, &c.,

S. L.

STEAM NAVIGATION.

THE MONGIBELLO STEAM SHIP.

This fine vessel belonging to the Neapolitan Steam Navigation Company at Naples, is fitted with a pair of Messrs. Maudslay, Sons and Field's patent double cylinder engines, of the nominal power of 200 horses; their general principle is described in the last volume of the Journal, page 73.

The improvements realized in this description of engine are *first*, that the power is applied more directly to the cranks than in any other construction, having only two working joints through which the power is conveyed, viz. the lower and upper ends of the connecting rod, the stroke being of the usual length, and the connecting rod of the usual proportions; the force of the engine is also so completely confined within its own framing, that no strain is thrown upon the vessel. The *second* advantage is that the space occupied by the engine, is not greater than in an engine of half the power, on the side beam construction, and when combined with their improved boilers, (as is the case on board the Mongibello), the total length occupied by the machinery is reduced to 40 feet, whereas the ordinary construction requires 60 feet, thus effecting a saving of one-third, on this most important head. The *third* advantage arises from the reduction in weight, which in the Mongibello, and including water in the boilers, was 150 tons, being 13¼ cwt. per horse power, instead of one ton per horse power, which is the weight in beam engines, and even this is often much exceeded.

These advantages, which bear so strictly upon the profitable employment of steam vessels, are fully realized in the one in question, which is of 500 tons burthen, being 156 feet long, and 26 feet beam; besides the saving in space referred to above, the machinery of the Mongibello is about 70 ton lighter than ordinary beam engines, and in addition to the increased tonnage

derived from the saving in space. She thus possesses 70 tons additional buoyancy for cargo, or coal, for a more extended voyage. Another consideration, which ought not to be overlooked, is that in building a vessel to carry a certain number of passengers, or quantity of cargo, the first cost of the vessel may be much reduced; the same space for passengers and tonnage for goods, may be obtained by a vessel of 70 tons less measurement, and the saving under this head cannot be estimated at less than 1400*l.* in a vessel of the size of the Mongibello, and it would be greater as the size increased.

These engines work with great steadiness and effect, making 25 strokes per minute, and performing from 11½ to 12 miles per hour. They are fitted with expansion gear, brine pumps, &c. In short the vessel is replete with every requisite for a sea-going ship.

RENNIE'S TRAPEZIUM PADDLE WHEEL.

In our number for March last, we enumerated some of the advantages which were likely to be derived from the adoption of the above invention in steam navigation; we have now the satisfaction to lay before our readers the results of a series of experiments which have been made on the efficacy of the Trapezium Paddle Wheels, in comparison with the common Rectangular Paddle Wheels. The Lords of the Admiralty having decided that the trial should be made upon a vessel of known qualities, fixed upon the African, an old gun brig which had been converted into a steamer, by two engines of 45 horse power put into her, as best calculated to give a comparative result. Accordingly the old paddles were removed, and a pair of trapezium wheels fixed in on the same shaft, which formerly served for the old wheels, so that with the exception of a slight alteration in the paddle boxes, no further additions were required. On the 14th of April last the whole being ready, the engines were set to work, and the vessel proceeded down the river to the measured mile in Long Reach.

The dimensions of the African are—length, 109 ft. 10 in. midship section; breadth, 24 ft. 10 in. semi-elliptical, bluff at the bows; depth, 12 feet full at the quarters. She is a good sea boat, but not calculated for high velocities, as compared with steam vessels of modern times.

The power of the engines is two of 45 horse power each, the number of strokes 29 to 30.

The velocity of the vessel at a load draught of 9 ft. 5 in. is nine miles per hour through still water.

According to a series of experiments made with the African by Mr. Kingston, Admiralty engineer, the diameter of the old wheel was 14 ft. 7 in., the width 7 feet, the area of the floats immersed was about 62 feet super., the mean draught of the vessel was 9 ft. 4½ in., and with the barometer at 26¾ inches, and the engines making from 29 to 30 strokes per minute, the maximum mean velocity opposite the measured mile was 9·174 miles per hour.

	miles per hour.
On the 14th of April last, the engines making from 22 to 23½ strokes	8·29 to 8·75
On the 26th April, 23 strokes	8·4 to 8·6
On the 1st of May, 25 to 28½ strokes	8·8 to 9·032
On the 8th of May, 25 strokes	8·6 to 8·8
On the 12th of May, 26 to 27½	8·5 to 9·136

The last results were obtained with from 2½ strokes of the engines less than formerly, and with a reduced diameter of wheel of 22 inches, and an immersed surface of 30 square feet. The action of the float in the water was entirely free from shocks or vibration; thus establishing on a greater scale than hitherto, the properties of the trapezium wheel as promulgated in the prospectus, namely, that it combines all the advantages of the common paddle wheel, and does away with all its defects, arising as before stated, from the great weight, width, and indirect action of the former, and combining all and even greater simplicity of the latter.

The Steam Frigate "Styx."—On the 6th of May an experimental trip was made with this vessel down the river as far as Gravesend. There was present a numerous party of naval and scientific gentlemen, among whom were Lord Prudhoe, Admiral Sir Philip Durham, Sir W. Symonds, Chevalier Benkhausen, the Russian Consul General, Mr. Routh, &c. She is what is termed a second class government steam frigate, and the third vessel of that class fitted within the last six months. Altogether there will be five vessels, viz., The "Driver," "Vixen," "Styx," "Growler," and "Geiser," the two latter are not yet finished; they are all built to one mould, under the direction of Sir William Symonds, and to be fitted with engines by Messrs. J. & S. Seaward & Capel. The dimensions of the "Styx" are, length 210 feet over all, or 185 feet between perpendiculars, 36 feet breadth of beam, and 21 feet depth of hold; she draws 13 feet aft and 12 feet forward, and when laden with her full complement of guns, stores, &c., 15 feet aft and 14 ft. 6 in. forward. She is to carry four 8 inch guns, for 64 lb. hollow shot, and two 10 inch guns on swivels and slide beds for 96 lb. hollow shot. The two engines are of the collective power of 560 horse power; the cylinders are 62 inches diameter, and 5 ft. 8 in. stroke, performing 17 strokes per minute; the paddle-wheel is 26 feet external diameter, breadth of float boards 8 ft 3 in, divided into two, each being 11 inches wide. The engines are upon Messrs. Seaward's patent principle, the action being applied direct from the piston rod to the crank of the paddle shaft, as adopted on board the "Cyclops." Drawings and a description of these engines will be found in the Journal for February last. Mr. Samuel Seaward has also applied his patent for disconnecting the paddle wheels, which is extremely simple and efficacious; it only required 3 minutes to disconnect one of the wheels, and 4 minutes to reconnect it, and we have no doubt if the men had had a little more experience, they could have been connected and disconnected in half that time. The engines worked very beautifully, and free from the slightest vibration; the speed through still water was at the rate of about 10¾ miles per hour. During the excursion the company were entertained with a sumptuous collation.

Blackwall Steamers.—The Blackwall Railway Company have had three iron steamers built by Messrs. Ditchburn and Mair, to run from the Brunswick Pier to Gravesend, viz. the "Brunswick," "Railway," and "Blackwall," all of one mould. Their length is 146 feet and 19 ft. beam. The mould is beautiful, the bows being remarkably sharp, and throwing but little, if any, wave in front; the cabins are tastefully finished, and do credit to the builders. Each vessel is fitted with engines of 90 horse power collectively, and all have tubular boilers. The *Brunswick* has a pair of oscillating engines by Messrs. J. & S. Seaward & Capel, and the same description of engines are on board the *Railway* fitted by Messrs. John Penn & Son. We were present at an experimental trip of this boat on Saturday the 8th ult., when her speed exceeded that of any other boat on the river; indeed her average is about 16 miles per hour. Her performance gave great satisfaction to the Directors of the Railway who were on board, and to the company generally. The whole of the machinery including the boilers is only 45¾ tons in weight, very little more than one half the usual weight of engines of so large a power. The other vessel, the "*Blackwall*," has a single steeple engine of 90 horse power fitted with tubular boilers by Messrs. Miller, Ravenhill & Co. We understand that the speed of this vessel is nearly equal to that of the "*Railway*."

The Elberfelt.—This splendid vessel built of iron by Messrs. Ditchburn and Mair, for navigating the Rhine, performed an experiment trip on the Thames on the 8th instant. Her dimensions are, length 176 feet, beam 21 feet, depth 11 ft. 6 in., and draws only 2 ft. 8 in. of water, her cabins are fitted up with great taste, particularly the ladies cabin, and the saloon which is decorated with views on the Thames,—throughout the vessel every attention has been paid to the comforts of the traveller. She is propelled by a pair of oscillating engines of 55 horse power each, by Messrs. Miller, Ravenhill and Co., her speed in still water is calculated at 13 miles per hour; the boilers are tubular, of Mr. Spiller's patent.

Steam Frigates.—The town of Greenock exhibits at present a scene of no common interest. Six large steam frigates are now being constructed in the town or its vicinity, each of these of about 1,500 tons capacity, and carrying engines of 500 horse power, being part of the fleet of 14 armed frigates destined in time of peace to carry out and distribute the mails among our West Indian colonies. Four of these are to be supplied by a single firm in Greenock, who deliver the ships, engines, and equipments complete, and ready for sea. We announced a short time ago the successful launch of the first of these four, the Clyde, which was constructed by the late Mr. Duncan. The second of these ships, the Tweed, was launched from the yard of Messrs. Thompson and Spiers on Saturday last, and we hope soon to announce the completion of the series of these four sister ships, in the launch of the Tay and the Teviot, which are rapidly progressing on the stocks. In general appearance and construction this ship resembles closely her precursor, the Clyde, being slightly fuller forward, and finer abaft. To the eye she also seems larger than the Clyde, but this may arise from the latter being a foot or two deeper in the water, having already her whole engines and boilers fitted up on board, although it is only about two months since her launch. The dimensions of the Tweed are as follow:—Length, over all, 240 feet; keel and forerake, 215; beam, 37; depth, 30.—*Greenock paper.*

Thames Steamers.—The competition among the steamers has become so great, and their numbers have so much increased of late, that 17 vessels are daily engaged in conveying passengers between Gravesend and London. Some of them charge 2*s.* in the after cabin, and 1*s.* 6*d.* in the fore part of the steamer, for each passenger; others 1*s.* 6*d.* and 1*s.*, and a few 1*s.* only all over the vessel; while the steamers from Blackwall to Gravesend convey passengers for 8*d.* each. Fourteen steam vessels are engaged in carrying passengers between London and Greenwich, and a majority of them have lately reduced their fares to 6*d.* each; but the pier dues swallow up one-third of the fare, and it is doubtful whether the steam boat companies will be able to continue the reduced fares for any length of time. Eight steamers are constantly running to and from Woolwich, and they will receive a great accession in a few days by the fast and elegant boats of the Watermens' Steam-packet Company. There are 16 small vessels belonging to different companies steaming away from morn till night above bridge, and on Sunday last they carried upwards of 55,000 passengers, at 4*d.* per head, between the numerous piers from London-bridge to Chelsea.—*Times.*

Improvement in the Construction of Steam Ships.—A Correspondent of the *Times* suggests that safety bulkheads, by which a vessel is divided into three or four water-tight compartments, should be introduced into ocean steamers in future. The suggestion is an excellent one, but it ought to be enforced by legislative authority, and applied to all steamers. Many lives and much valuable property would have been saved if such a regulation had been in force since steam navigation has been so largely extended. The loss of the Phœnix, which was struck before the paddle-box by another large steamer at sea, affords one instance; and the Albion, on her voyage from Dublin to Bristol, touched a sunken rock on the Welch coast, and immediately went down in comparatively smooth water, and on a beautiful day, in consequence of the leak produced in her bow. The distressing loss of the Killarney, on the coast of Cork, would, no doubt, have been averted, had not the fires in the engine-room been extinguished by a leak, which it was impossible to keep down. Many other cases might be cited; and we shall place in juxtaposition with the preceding an accident which happened to the Royal William a celebrated steamer belonging to the City of Dublin Company, on one of her voyages from London to Dublin. This vessel, we must premise, like several others belonging to the same spirited company, is divided into water-tight compartments by bulkheads. One dark stormy night, when off the Isle of Wight, she suddenly came into violent collision with a three-masted ship,

which exhibited no lights; and a large hole was made in her bow, which must, had she been built like ordinary steamers, have involved her almost instantly in the same fate as the Albion. The bulkhead, however, near her bow, prevented the leak from spreading—nay, so little inconvenience did this alarming collision occasion, that she proceeded on her voyage to Plymouth, scarcely depressed in the slightest degree, to use nautical language, "by the head." This is a striking anecdote; and we only wonder that steam-boat proprietors have not long ago seen the importance, even for their own interest, of adopting the mode of construction which saved the Royal William. We repeat that that they ought to be compelled to do so; and we trust that some member of Parliament will bring the subject forward without delay. We are not able to say whether some such safeguard might or might not be adopted in ships; but the recent frightful loss of life occasioned by the sinking of the Governor Fenner, owing to a collision with a steamer, ought at all events to draw attention to the subject. In the Thames 1,000 or 1,200 persons often trust themselves in a single steamer of comparatively slight construction.—*Glocestershire Chronicle.*

Launch of a Steam Frigate.—The West India Royal Mail Steam-packet Company's magnificent and powerful steam ship the Forth was launched from the building-yard of Messrs. Robert Menzies and Sons, Leith, on Saturday last. She glided into the Forth, the estuary after which she has been called, in a most majestic manner, and in presence, it is reported, of not fewer than 80,000 spectators. So gay a scene had not been witnessed in Leith since the visit of his late Majesty George IV., in August, 1822. The following are the dimensions of the Forth:—Length of keel, 215 feet; on the spar deck, 229 feet; over all, 245 feet; breadth over paddle-boxes, 60 feet; depth of hold, 30 feet 3 inches; tonnage, 1,940. She is to be propelled by two engines now fitting at Liverpool by Mr. Bury, of 220 horse-power each. The Forth is the third steam frigate already launched for the West India Royal Mail Steam-packet Company. The two first were built on the banks of the Clyde.

Steam-ship Building in Derry.—In Mr. Coppin's yard there has been laid the keel of a vessel intended for foreign trade, which, in point of dimensions, will come very little short of the largest steamers ever built, the proprietors of her being partly Englishmen. She is to be impelled by the Archimedean screw, to have a horse-power of between 500 and 600, and to be of 1,500 tons register. Her keel is 221 feet, only a few feet inferior to that of the greatest steamer launched, and her length over all will be 230 feet.—*Derry Journal.*

MISCELLANEA.

Westminster Bridge is again opened to traffic, after having, during the short period of four weeks, been subjected to extensive repairs. The well-known hollow arch has been removed, and spandrel walls with longitudinal arches in brickwork have been substituted, so as not only to strengthen the pier, but to remove a serious cause of danger, threatened by the pressure of the hollow arch on the haunches of the adjoining main arches. A rather unusual circumstance has been the removal and restoration of a whole course of stone throughout one arch. Great satisfaction has been given by the prompt and energetic manner in which the alterations have been effected by Mr. Cubitt, under the directions of the engineers, Messrs. Walker & Burgess.

Preston and Wyre Railway, Harbour and Dock Company.—Extract from a report to the directors by Captain Denham, at the last half-yearly meeting of the proprietors.—"The new channel through the 'Knot-spit,' and over the 'Little Ford,' has been so deepened as now to afford 13 feet of water at half tide through the straight course thus produced upon the line of lights direct from sea into the harbour. The present period is occupied in dredging up the shelving bottom between the landing wharf and 'Canshe-hole' anchorage, so as to produce a continuous depth of 12 feet at low water spring tides, an object we hope to attain by June next, during which the upper layer of shelving shore now interrupting the north or early approach to the wharf, will be excavated, leaving the under or lower shelf to be dredged down to 12 feet over the whole space across to 'Canshe-hole.' The dredge's service this year will thus be wholly dedicated to the wharf frontage and approaches. The new Channel to Sea will, however, be improved by excavating and carrying away at low water the remainder of the 'Knot-spit,' and trimming down the surface and marginal projections of the new cut or channel, the marl arising from which will be appropriated to the 'neckings' half tide wier about to be constructed on the opposite side of the channel. This latter work will also be prosecuted this year, and additional pontoons and stone flats are preparing for it. This tide wier will have the effect of concentrating the whole volume of back water, the scouring force of which has already been so essentially increased by the completion of the 'Knot-gulph' embankment."

Florence and Leghorn Railway.—A supplement to the *Florence Gazette* of the 27th April, contains the decree of H. I. and R. Highness, the Grand Duke of Tuscany, granting for the term of 100 years (to be reckoned from the time when it will be completed and opened to the public), the railway from Florence to Leghorn, to the Company announced by the Manifest of Fenzi and Senn of the 24th April, 1838, to be executed according to the report of the celebrated English engineer, Robert Stephenson, Esq. His Imperial and Royal Highness graciously allows said railway to bear his royal name of "Leopold," and grants numerous advantages and privileges, among others *the importation duty free, of all the iron works, machinery, locomotives, and every other article required for its construction, and completely placing it in active operation.* The exemption from the register stamp due on all the deeds of the company during the construction of the railway, the option of converting into perpetual leaseholds the amount of such lands as will be occupied by the company, and which may belong to the state, or to religious corporations, and which from its nature should be subject to re-investment. The right of expropriation fixed on a liberal basis, with the right of immediate occupation, and a low tariff for the transport of persons and goods.

COPPER MINE.—The copper mine recently discovered in Jamaica is situate in Mount Vernon, a huge mountain six miles to the East of Kingston. The lodes run from east to west, with a dip to the north. The veins of ore are found in the neighbourhood of Lucky Valley estate, in the parish of Port Royal, and at the base of the mountain. The richest ore is a sulphurte, yielding 40 per cent. of metal. This ore is obtained in immense quantities from a shaft which opens on a small stream sufficient to carry away the debris. Several hundredweights have been sent to London and Swansea for smelting, great difficulty having been experienced in performing this operation perfectly in Jamaica, from the want of reverberatory furnaces. There is also a carbonate which yields 11 per cent. of metal by the humid process. This is a very beautiful ore, and occurs in what is called abon rock. The matrix consists principally of lime-stone, argillaceous sand-stone, slate, schist, and a fine black sand-stone. The black sulphuret, which is abundant, is obtained in masses resembling wet and rotten coals, soft when extracted from the mine, but hardens in the sun, and is full of pyrites. When dry it is perfectly friable. The situation of the mine is convenient, being only three miles and a half from the sea, and the road is a gradual descent to the harbour, Bull Bay, where there is good anchorage for vessels. It may be added that the mine is in full operation, a company having been formed, and all the shares bought up. When the packet left Jamaica, Senor Don Rennaldo, the captain of the Cuban mines, had been applied to for assistance and advice, and was daily expected there.

Consumption of Smoke.—We have great pleasure in directing public attention to the efficacy of Hall's apparatus for the consumption of smoke from steam engine chimnies. Mr. Hall has just completed one at the manufactory of Messrs. Boden and Morley, in Castle-street, in this Borough, which from its efficacy, if generally adopted, will leave no cause of complaint from what has hitherto been a source of annoyance to the inhabitants of the borough. The furnace is supplied by a current of air heated by the furnace itself, which, when in full operation, completely consumes the volume of dense smoke, which is frequently sent forth from the chimney of a steam-engine. Of course this cannot be done till the fire is got up in the morning, and whenever the furnace door is opened for feeding, the apparatus ceases to act; but half a minute suffices to clear the chimney, when the furnace door is shut, and then, however thick and dark the smoke was previously, the quantity is immediately greatly reduced and its density gives place to a silvery hue. We believe the apparatus saves something considerable in fuel, and we are sure its adoption will be hailed with general approbation by the inhabitants of this borough.—*Derby Reporter.*—A short time ago, our columns contained a notice of the perfect consumption of smoke by apparatus applied to the steam engine of Messrs. Benjamin Cort and Co., of this town; it has also been used with equal success as applied to other steam engines, both here and at Derby. We are highly gratified at being informed that this invention answers equally well with locomotive engines. A trial was made of it, as attached to the "Wizard," a few days ago, on the Midland Counties Railway, in the presence of some of the directors of the company, and of several other gentlemen; of the former were William Hannay, Esq., and Henry Youle, Esq., and of the latter were Francis Wright, Esq., of Lenton Hall, H. B. Campbell, Esq., &c., who all expressed their high approbation of its satisfactory operation. The above apparatus for which a patent was taken out in January last, is the invention of Mr. Samuel Hall, the inventor of the condensers (known under his name), for supplying pure distilled water instead of salt or otherwise impure water to the boilers of marine and other steam engines, as well as the inventor of the reefing paddle wheel for steam vessels. The importance to railway companies of being able to use coal instead of the costly article of coke to locomotive engines, can scarcely be estimated, so greatly must it reduce the expense of the transit of passengers and goods, and consequently increase the profits of the shareholders.—*Nottingham Review.*

Dorsetshire.—The body of the church of St. Mary's, Wareham, Dorset, is now being pulled down for the purpose of being rebuilt. This part has evidently been already once before pulled down and rebuilt, the nave being divided from the side aisles by square massive piers of rough rubble construction, with impost and archivolt mouldings of a Roman character. This alteration was possibly done towards the latter end of the 17th, or beginning of the 18th century. The workmen have found in the walls some fragments of stone with curious carvings and inscriptions. There is a fine tower and spacious chancel of decorated Gothic which will not be touched, and attached is a small sepulchral chapel with tombs of cross legged knights in chain armour. The new church provides accommodation for 1000 persons. The contract has been taken by Messrs. Cornick and Son, of Bridport, Dorset, and the works are to be completed by Michaelmas 1842; under the superintendence of Mr. T. L. Donaldson, architect, by whom also a new Scotch Church is to be erected at Woolwich, in the Norman style, with accommodation for 1000 persons, half of whom will be soldiers of the garrison. The plot of ground for the church and schools, which are to be erected in connexion, has been given by the Government, in consideration of the sittings, which will be provided for the troops of the Kirk communion.

Mr. Stephenson's Lime Works at Amber Gate.—Mr. Stephenson has now commenced burning lime at these works, and is sending it to the different places adjacent to the North Midland Railway. In the course of a short time it will be conveyed to most of the principal towns in England. The kilns are built in a handsome and substantial form, standing from 30 to 40 feet above the surface of the ground. The limestone is procured from the village of Crich, about two or three miles distant from the kilns, on a tramway formed for that purpose. A short distance from Crich, the tramway passes through a tunnel between 50 and 60 yards in length; a little further on is an inclined plane, worked by a wheel, which lets down six wagons full of limestone, and draws up the same number of empty wagons. Nearly adjoining this is another inclined plane, which is uncommonly steep, rising at the rapid rate of one yard in three and a half, and is worked by a large drum, round which passes a wire-rope; a lever is attached to the drum, by which

one man alone is able to regulate the speed of the wagons at pleasure, or stop them altogether. Two full wagons are let down and two empty ones are drawn up at the same time. The full wagons pass over the Cromford canal by a wooden bridge (elevated several feet above the surface of the water) to the top of the kilns. These stupendous works, when finished, will be of the most extensive character in England, or we may say in the whole world. They will, when complete, be able to turn out upwards of 200 tons of lime per day.—*Sheffield Patriot.*

Victoria Park Bill.—The Bill authorising the Woods and Forest to form a Park in the eastern part of the metropolis, has already past the House of Commons.

The bronze statue of Rubens is at length completed, and has been sent from Liège to Antwerp, the place of its destination.

Parisian Bitumen.—The terraces at the Slough station of the Great Western Railway are being lined with this material. its use has of late been considerably on the increase; it has been introduced in several parts of the metropolis.

LITERARY NOTICES.

Mr. Dollman has given the public two faithful representations of the restorations of the Vicar's Close at Wells, the details of which are given in Mr. Walker's book. The chimneys we think felicitous, but the sentry-box porches might, we conceive, without injury have been omitted by the architect; fidelity of this kind savours too much of the ingenuousness of the Chinese tailor, who treated the patches in the pattern coat as an essential part of the workmanship.

Mr. E. Clifford, a teacher of mathematics, has brought out a small treatise styled *Arithmetic Considerations on Marquoi's Parallel Scales, and the Protractor*, which contains a number of useful calculations and directions.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 29TH APRIL, TO 27TH MAY, 1841.

Six Months allowed for Enrolment.

JAMES SIMS, of Redruth, Cornwall, civil engineer, for "*certain improvements in steam engines.*"—April 29.

ALFRED JEFFERY, of Prospect-place, New Hampton, Middlesex, gentleman, for "*a new method of defending the sheathing of ships and of protecting their sides and bottoms.*"—April 29.

GEORGE TOWNSHEND, of Sorpcote-fields, Leicester, Esquire, for "*improvements in machinery or apparatus for cutting certain vegetable substances.*"—April 29.

JOSEPH GIBBS, of Kennington, civil engineer, for "*a new combination of materials for making bricks, tiles, pottery, and other useful articles, and a machine or machinery for making the same, and also a new mode or process of burning the same, which machine or machinery and mode or process of burning are also applicable to the making and burning of other descriptions of bricks, tiles, and pottery.*"—April 29.

MILES BERRY, of Chancery-lane, for "*certain improvements in machinery or apparatus for making or manufacturing nails and brads.*" (A communication.)—May 4.

FRANCIS JOSEPH MASSEY, of Chadwell-street, Middleton-square, watch manufacturer, for "*improvements in the method of winding up watches and other time keepers.*"—May 4.

EDWARD NEWTON, of Leicester, manufacturer, and THOMAS ARCHBOLD, of the same place, machinist, for "*improvements in producing ornamental or tambour work in the manufacture of gloves.*"—May 4.

CHARLES THOMAS HOLCOMBE, of Bankside, Southwark, iron merchant, for "*certain lubricating or preserving matters for wheels and axles, applicable also to the bearings, journals, or other parts of machinery.*"—May 4.

HUGH GRAHAM, of Bridport-place, Hoxton, artisan, for "*an improved manufacture of that kind of carpeting, usually denominated Kidderminster carpetting.*"—May 6.

MOSES POOLE, of Lincoln's Inn, Esquire, for "*improvements in the manufacture of fabrics by felting.*" (A communication.)—May 6.

PHILEMON AUGUSTINE MORLEY, of Birmingham, manufacturer, for "*certain improvements in the manufacture of sugar moulds, dish covers, and other articles of similar manufacture.*"—May 6.

JAMES HANCOCK, of Sidney-square, Mile End, civil engineer, for "*certain improvements in the manufacture of locks, keys, latches, and other fastenings, part of which improvements are applicable to taps and cocks for drawing off fluids.*"—May 6.

JOHN PALEY, jun., of Preston, Lancashire, manufacturer, for "*certain improvements in looms for weaving.*"—May 10.

HOOTON DEVERILL, of Nottingham, lace manufacturer, for "*certain improvements in machinery for making and ornamenting lace, commonly called bobbin net lace,*"—May 10.

ANDREW MC NAB, of Paisley, North Britain, engineer, for "*certain improvements in the manufacture of bricks.*"—May 11.

EDMUND TAYLOR, of King William-street, gentleman, for "*certain improvements in the construction of carriages used on railroads.*" (A communication.)—May 11.

HENRY PINKUS, of Maddox-street, Hanover-square, for "*an improved method or methods of applying electrical currents or electricity, either frictional, atmospheric, voltaic, or electro magnetic.*"—May 14.

JAMES GREGORY, coal master, and WILLIAM GREEN, turner, both of West Bromwich, Stafford, for "*certain improvements in the manufacture of iron and steel.*"—May 14.

PIERRE JOURNET, of Dean-street, Soho, engineer, for "*improvements in fire-escapes, which improvements are applicable to other useful purposes.*"—May 19.

JOHN CARR, junior, of Paddington, engineer, for "*improvements in apparatus for retarding and stopping railway-carriages.*"—May 20.

CHARLES PHILLIPS, of Chipping Norton, Oxford, engineer, for "*improvements in reaping and cutting vegetable substances as food for cattle.*"—May 20.

JOSEPH WOODS, of Lawn-place, Lambeth, Surrey, civil engineer, for "*certain improvements in locomotive engines, and also for certain improvements in the machinery for the production of rotatory motion for obtaining mechanical power, which improvements in machinery are also applicable for raising or impelling fluids.*"—May 22.

WILLIAM GALL, of Beresford-terrace, Surrey, for "*certain improvements in the construction of inkstands.*" (A communication.)—May 22.

JOHN AINSLIE, farmer, Redheugh, North Britain, for "*a new and improved mode of making or moulding tiles, bricks, retorts, and such like work from clay, and other plastic substances.*"—May 22; four months.

CHRISTOPHER DUMONT, of Mark-lane, London, for "*improvements in the manufacture of metallic letters, figures, and other devices.*" (A communication.)—May 22.

JOHN WINTERBORN, of Clarence-place, Hackney-road, surgeon, for "*improvements in machinery to facilitate the removal of persons and property from premises, in cases of fire; which improvements are applicable to raising and lowering weights generally, to assist servants cleaning windows, and as a substitute for scaffolding.*"—May 22.

WILLIAM LEWIS RHAM, of Winkfield, Berks, clerk, for "*certain improvements in machinery or apparatus for preparing land, and sowing or depositing grain, seeds, and manure.*"—May 22.

JOHN WHITEHOUSE, of Deptford, engineer, for "*an improved method of making boilers, to be used in marine steam engines.*"—May 22.

WILLIAM JOEST, of Ludgate-hill, merchant, for "*improvements in propelling vessels.*" (A communication.)—May 26.

GEORGE HULME, of Saint John-street, Smithfield, cock founder, for "*improvements in water closets.*"—May 27.

JOSEPH BETTRIDGE, of Birmingham, wood turner, for "*an improved method of manufacturing papier mache, pearl, china, ivory, horn, wood, and composition, into pillars and stands for table and other lamps, and other articles of domestic furniture.*"—May 27.

JAMES SHANKS, of Saint Helen's, Lancashire, chemist, for "*improvements in the manufacture of carbonate of soda.*"—May 27.

TO CORRESPONDENTS.

Communications from M.R., Daniel Clark, *&c., received too late will appear next month.*

We have received a proposition for forming "An Association of Architectural and Engineering Draughtsmen," which we have deferred for consideration until next month.

Communications are requested to be addressed to "The Editor of the Civil Engineer, and Architect's Journal," *No. 11, Parliament Street, Westminster.*

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, and III, may be had, bound in cloth, price £1 each Volume.

ERRATA.

In last month's Journal, p. 178, for *Harry* Austin read *Henry* Austin.

P. 129, for Mr. Edward Hall (late of *Birmingham*) read late of *Manchester*.

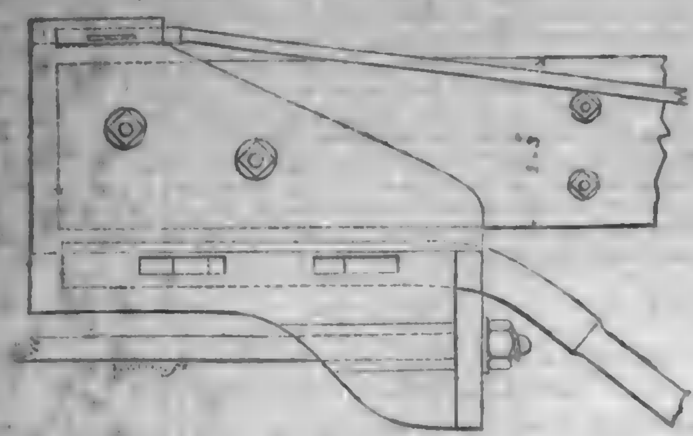
The type of pages 151 and 152, after it was made up, got disarranged; we have consequently reprinted them, which are given with the present number. We have to request our readers to cancel those pages, and substitute those given herewith.

NEW FORM OF VIADUCT.

(With an Engraving, Plate VII.)

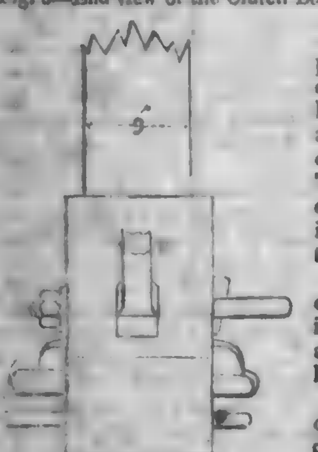
The accompanying drawings show a new species of viaduct that has been made use of as a general design, in the parliamentary estimate of a recently surveyed Railway.

Fig. 4—Side view of the Clutch Box D.



The principle in its simple form, is not new to the engineering world, having been put into execution in the "Foot bridge over the Whitadder, at Abbey St. Bathans," (see Theory, Practice, and Architecture of Bridges, part four,) and being commonly used in temporary erections, scaffolding, &c., and frequently applied in strengthening various kinds of vehicles. The novelty consists in carrying out the idea to the magnitude of the present case.

Fig. 5—End view of the Clutch Box C.

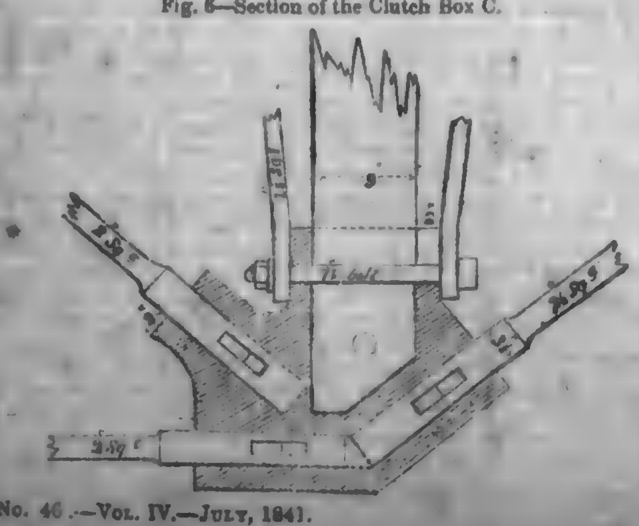


It will be seen that the system is applicable on a great scale, in those cases only where there is a large amount of headway to spare, as the efficiency of the arrangement is so completely dependant on the inclination of the tension bars. The estimation of the strength in the original form, is a matter of great ease, involving only a simple case of resolution of forces.

This design is made for a single line of rails only, but it would appear that it might be much more advantageously and economically applied to a double line.

A reference to the drawing will preclude the necessity of any detailed description, and it will be necessary merely to draw attention to the more important points. It will be seen that the application of the tension bars is not confined to the resistance to vertical deflection, but that it is made use of in given lateral strength to the main supports, (inverted tressels would perhaps be the most descriptive term), their bending being prevented in one direction by the transverse studs and tie-bolts, and in the other by the tension of the iron rods.

Fig. 6—Section of the Clutch Box C.



A weight entering upon the bridge will be perceived to immediately distribute its effects over the whole structure, by means of the ascending intermediate bars; these bars will effectually prevent any partial deflection that might be expected to occur upon an unequal distribution of the load.

It will be observed that rods are dotted in, and noted as being carried to the sides of the piers, to prevent any lateral oscillation; little fear of this however need be entertained, as the surface exposed to the wind would be so slight; nevertheless if there were any apprehension of such an effect, it might be further guarded against, by a divergence, of the sides of the supports, as shown by the dotted lines at D′, D′, on the transverse section; and this would be done with very little diminution of strength. In a double line there would be no need of such precaution.

The estimated cost, including scaffolding, &c., and exclusive of piers, is 6*l.* per lineal foot; the quantities I took out myself, and can bear testimony to their fulness; the prices were given by another, and were high in consequence of the difficulty of the localities; in short I believe that the above price is rather more than would be the cost in average cases. With regard to the strength, I think it will be found by any one who will be at the trouble to calculate it, that it is if any thing greater than what is stated.

To those with whom appearance is the main point in railway works, the design will probably afford some amusement; but every one will I think perceive that elegance of effect is not attempted, an economical and durable structure being the only object in view.

Herbert Spencer.

Derby, May 11, 1841.

Reference to Drawings.

Fig. 1, Plate VII. is a side view of the bridge, part of the span is omitted in order that the remainder might be kept to as large a scale as the size of the Journal would admit. Fig. 2, is a transverse section of one of the suspensions or the cross trusses; and fig. 3, a transverse section of the centre suspension or cross truss. Fig. 4, enlarged view of the clutch box D, secured to the piers. Fig. 5, end view of the clutch box C; and fig. 6, a section of the same. The three last figures are drawn to a scale of ¾ of an inch to a foot.

CONDUCT OF THE GOVERNMENT TOWARDS THE ENGINEERING INTERESTS.

We have, on more than one occasion, thought it our duty to call the attention of our readers to the conduct which has long been pursued by the government and the legislature, as to all measures bearing upon the interests of the engineering profession. We are well aware that many of these measures, although weighing most strongly upon the engineers were directed against other interests, and cannot therefore be considered as purposely levelled against the profession; but, nevertheless, when we observe the tendency of measures more direct, and the uniform tenor of these proceedings, we are obliged to admit that either the policy or the inclination of the governing body is constantly directed to our injury. In whatever way we examine the measures affecting us we are impressed with this feeling, and now that we are enabled to look back and class together isolated events, we find an accumulation of evil in the highest degree threatening the profession. On the one hand our employment is proposed to be taken from us, and on the other we are to be placed under the government direction and control; so that both our moral and physical interests are equally concerned. It is perhaps fortunate that circumstances have intervened to prevent every attempt from being effective, but still a sufficient amount of mischief has been perpetrated to call for the serious attention of every one to the position in which he is placed. It might have been well at a former period for the civil engineer to say, that affects the marine engineer or the capitalist and not me, or for the practical engineer to say that has nothing to do with me, but now when we come to review the whole of these proceedings we find something which affects each individual branch, while there no longer remains a doubt that the whole body is in danger. What engineer when he considers the several government measures of the last four years can now flatter himself that he is safe, and that the attack on his neighbour is imminent of no danger to himself? Let him look at the Ten Per Cent. Deposit Clause, the Irish Railway Scheme, the Steam Navigation Bill and the Railways Bill; let him read the speeches of ministers, the reports of committees and commissioners, and the suggestions of commissioners, let

him reflect on what has been attempted and then say if he dare to assign any limit to their future aggressions. We feel that the period has now arisen when it becomes the profession in a collective capacity to do in all its power for resisting present attempts, preventing future invasions, and remedying past evils, and unless these things be done and be done quickly too, we very much fear that an amount of distress and inconvenience will be inflicted on every individual, such as to make him bitterly regret his inactivity.

The Standing Order of the House of Commons requiring the payment of a deposit into the Bank of England of ten per cent. on the proposed capital of all public works, is a regulation the evils of which we have long deprecated. Many have shut their eyes under the delusion that either the order would be repealed from a conviction of its inefficiency, or such a change would take place in the money market as would enable it to be complied with. We were never so insane, for we considered that the same ignorance, which could lead to such an enactment in the teeth of reason and experience, would blind its partisans to any defect in its operations, and that whether the money market were either in a sound or unsound state, the impediment would be equally serious. The evils which have arisen to the profession from the stagnation of affairs have been quite enough without any aggravation, but now whatever may be the means or disposition of the monied interest, three years have passed over without a single act having passed for any public work of importance. After the present year we really cannot see where employment for a large part of the profession is to be obtained, for there will be neither railways, canals, docks, harbours, bridges, gas nor water works to be constructed, and no prospect, with means however abundant, of obtaining acts of parliament, except after the long period required by the standing orders. We foresaw what the result would be, and we gave warning of it, if therefore every one has remained lukewarm it has been from no default or neglect on our part, and those who will suffer will have themselves to blame for the event. The engineers must petition and obtain petitions from other parties for the redress of the grievances caused by the Ten Per Cent. Clause, for they may readily see that unless they put their shoulders to the wheel and sturdily too, no relief will they obtain. When an honourable member rose the last session to move for a reduction in the amount of the deposit, how was he supported, and what was the language of the President of the Board of Trade, the mouthpiece of that department in which all our evils have originated? He actually declared that no diminution in the number of acts had taken place, that no mischief was caused by the Standing Order, and finished by referring triumphantly to the number of notices then before the House of application for acts. Had he but enquired how many of these applications were rejected for non-compliance with this very regulation, and if he had enquired at the end of the session how many acts had passed, he would find that the account was merely a blank.

The Irish Railway Report, and the new Irish Railway scheme, are further developments of the same system; the progress of railways in Ireland has been checked, and the management of such as may be made is proposed to be entrusted to the government, the most inefficient body for the purpose which could possibly be selected, and which has already filled Ireland with monuments of jobbery and mismanagement. This new scheme must also be opposed as an emanation from the same stock, and as calculated by acting as a precedent to be productive of more immediate evil. The Steam Navigation bill exhibited, in all its deformity, the grasping ambition of the Board of Trade; the genius of our engineers was to be controlled, their plans revised, and their workshops taken from under their own management, and placed under the inquisitorial power of the government. The marine engineers were aroused, and the evil was warded off, but it must not be thought that an end is put to the existence of this monster, 'the snake is not killed but scotched,' and the spirit which animates it is too visible in the Railways Bill to allow us to doubt of its revival. These Railways Bills are too serious warnings of the danger of allowing the least tampering with our interests, to let us pass them by without calling the attention of our readers to the evils which are threatened by them. Discretionary powers are asked for, the future operation of which we are too well able to trace in those "shadows of coming events," the "Reports and Papers relating to Railways," presented to Parliament. Here we see military ignoramuses interfering with every part of the construction of railways and locomotives, putting the designs of the engineers under supervision, and suggesting that the workshop of the manufacturer of locomotives should be subjected to an inquisition. In fact, if our space permitted us, we might, on this subject alone, draw a fearful picture of the mischief which is threatened to every branch of the profession. Enough has now been said to call for an interference, and we have only to say further, that experience has shown that even the slightest opposition has been sufficient to check the Board of Trade in its mid-career, and if a sturdy opposition be organized, we are not without hopes of having all the grievances redressed. We again recommend the engineers to lose no time, or the profession will be stripped of its independence, and their offices of all appearance of business.

Neither are the evils confined to the engineers, but equally threaten other and more numerous classes. It is acknowledged that it is to the railways and other public works that we, in a great degree, owe the employment of the working classes, and diminution of the poor rates, and any sudden cessation of employment must be productive of the most disastrous consequences. The contractors, also, and subcontractors employed, and the several classes of tradesmen and labourers connected with them, are exposed to consequences equally ruinous; not only will they be put out of work, but their plant, tools and materiel becoming useless, must be sold at ruinous prices. A large amount of capital, also, which was directly employed in promoting the progress of the nation, has been, during the suspension, diverted, being either hoarded or rendered comparatively idle. Considered, indeed, in every possible way, whether on the broadest grounds or the narrowest, the measures of the government equally refuse the test, the interests of the nation being sacrificed through narrow-mindedness, or a love of jobbery.

PLAN FOR A NEW ASSOCIATION OF ARCHITECTURAL AND ENGINEERING DRAUGHTSMEN.

Among the various means which may be adopted in order to attain any desirable object, the association of numerous individuals who have a common interest in it, is one which has often proved successful in cases where isolated energy would have been unavailing. This may be observed in various instances, whether in pursuits of public utility, of pleasure, of charity, or of a private advantage.

It is now intended to suggest to the consideration of those concerned, whether this principle of association, so largely applied at the present day to objects of great public concern, might not be made useful to those engaged in one department of the arts of design with which it has hitherto had perhaps but little connection.

That class of artists is here alluded to, who are employed in a subordinate capacity in preparing the necessary drawings required previously to the execution of any great work either of architecture or engineering, to furnish the necessary illustration for the artificers who are to carry it into practice, and for the proprietor who is to possess it when completed.

It may be true that the different societies already formed both of architects and engineers, may have the effect of adding to the general stock of information, of increasing the means of knowledge, and maintaining the character of each profession with the public; but the union now advocated, is intended to be of a more humble kind of utility, less exalted in its objects, less interesting to the imagination, but it is conceived, not less adapted to meet the wishes and supply the wants of a considerable number of individuals.

However it may be that the young student of architecture (by which perhaps he merely means the drawing of architectural decoration), flatters himself that he is pursuing a "fine art," including all the grand and elevating, and beautiful attributes that may be connected with the term, he will probably find sooner or later, (circumstanced as the art is in these utilitarian days), that he cannot pursue it professionally without making it a different sort of business; a pursuit in which the physical qualities of objects shall be more considered than the æsthetical, in which the combination of the various talents of others shall be preferred to the concentration of a single isolated mind upon a single visionary object, in which the useful shall triumph over the beautiful, and the matter of fact over the imaginative.

These observations are put forward as prefatory to the main object of this paper, which is to suggest the formation of an Association of Architectural and Engineering Draughtsmen, for the purpose of enabling them more readily to communicate with each other, and with those at whose hands they expect employment; and of affording to the latter class, the means of readily obtaining that assistance of which they may stand in need, on terms the most equitable to both parties.

To obtain these ends, the means now proposed are, the collecting together at a given place for public exhibition, a number of specimens of the abilities of members of the associated body, whether applied in the different ways which are found practically useful in business, or exerted to produce results more attractive to the eye at first sight. For there should not merely be a display of the heaven-ward aspirations of unfettered fancy, exerted upon castles in the air, bridges over chaos, temples for which even if already erected it would be difficult to contrive any useful destination, and palaces adapted to pursuits of

pleasure, unsuitable to our tastes, our habits, and to the climate of the country we inhabit; but places should also be assigned to those working drawings of common houses, and modern economical churches, those practical details of machinery, and surveys of parishes, and plans of estates, which would perhaps attract still more scrutiny from some of the frequenters of the proposed exhibition.

In reducing this plan to practice, several reasons might be alleged why the draughtsmen themselves ought to be the managers. They might make it one of their rules to be allowed respectively space for their drawings proportionable to the sums they subscribe to defray the necessary expenses. On the other hand contributions might also be levied from those whose curiosity led them to visit the collection, by the sale of catalogues, the possession of which might give a right of admission for a certain period.

The writer of these observations would be glad if they should have any effect in inducing others of the parties interested to join and carry his proposal into effect. Of course he would not be backward in lending his share of assistance so far as was within his limited means, and he should expect to be joined in doing so by some other of the younger members of the profession, who have expressed their concurrence in the views here expressed.

G. M.

ENGINEERING WORKS OF THE ANCIENTS, No. 6.

In our last we gave an account from Xenophon of the Athenian silver mines, which, by some inadvertence, was detached from this series of papers, and now we proceed to give what Diodorus Siculus says as to the gold mines of Ethiopia (Book 3.)

EGYPTIAN OR ETHIOPIAN GOLD MINES.

In the confines of Egypt and the neighbouring countries of Arabia and Ethiopia there is a place full of rich gold mines, out of which with much cost and pains of many labourers, gold is dug. The soil here naturally is black, but in the body of the earth, run many white veins, shining with white marble, (query quartz), and glistering with all sorts of other bright metals; out of which, laborious miners, those appointed overseers, cause the gold to be dug up by the labour of a vast multitude of people. For the kings of Egypt condemn to these mines notorious criminals, captives taken in war, persons sometimes falsely accused, or such against whom the king is incensed; and that not only they themselves, but sometimes all their kindred, and relations with them, are sent to work here, both to punish them, and by their labour to advance the profit and gain of the king. There are infinite numbers upon these accounts thrust down into these mines, all bound in fetters, where they work continually, without being permitted any rest day or night, and so strictly guarded, that there is no possibility or way left to make an escape. For they set over them barbarians, soldiers of various and strange languages, so that it is not possible to corrupt any of the guard, by discoursing one with another, or by gaining opportunities of familiar converse.

The earth which is hardest and full of gold, they soften by putting fire under it, and then work it out with their hands; the rocks thus softened, and made more pliant and yielding, several thousands of profligate wretches break it in pieces with hammers and pickaxes. There is one workman who is the overseer of the whole work, who marks out the stone, and shows the labourers the way and manner how he would have it done. Those that are the strongest amongst them, that are appointed to this slavery, provided with sharp iron pickaxes, cleave the marble shining rock by mere force and strength, and not by art of sleight of hand. They undermine not the rock in a direct line, but follow the bright shining vein of the mine. They carry lamps fastened to their foreheads to give them light, being otherwise in perfect darkness in the various windings and turnings wrought in the mine; and having their bodies appearing sometimes of one colour and sometimes of another (according to the nature of the mine where they work). They throw the lumps and pieces of the stone cut out of the rock upon the floor. And thus they are employed continually without intermission, at the very nod of the overseer or taskmaster, who lashes them severely besides. And there are little boys that attend upon the labourers in the mines, and with great labour and toil gather up the lumps and pieces hewn out of the rock as they are cast upon the ground, and carry them forth and lay them upon the bank. Those that are about thirty years of age take a piece of the rock of such a certain quantity, and pound it in a stone mortar with iron pestles till it be as small as a pea, then those little stones so pounded are taken from them by the women and older men who cast them into mills that stand together near at hand there in a long row, and two or three of them being employed at one mill, they grind it so long till it be as small as fine meal, according to the pattern given them. No care at all is taken of the bodies of these poor creatures, so that they have not a rag so much as to cover their nakedness, and no man that sees them can choose but must commiserate their sad and deplorable condition. For though they are sick, maimed or lamed, no rest nor intermission in the least is allowed them, neither the weakness of old age nor the infirmities of women are any plea to excuse them; but all are driven to their work with blows and cudgelling, till at length overborne with the intolerable weight of their misery, they drop down dead in the midst of their insufferable labours; so that these miserable creatures always expect worse to come than that which they at present endure, and therefore long for death as far more desirable than life.

At length the masters of the work take stone thus ground to powder, and carry it away in order to the perfecting of it. They spread the mineral so ground upon a broad board somewhat hollow and lying shelving, and pouring water upon it, rub it and cleanse it, and so all the earthy and drossy parts being separated from the rest by the water, it runs off the board, and the gold by reason of its weight remains behind. Then washing it several times again, they first rub it lightly with their hands, afterwards they draw up the earthy and drossy matter with slender sponges gently applied to the powdered dust, till it be clean pure gold. At last other workmen take it away by weight and measure, and they put it into earthen urns, and according to the quantity of the gold in every urn, they mix it with some lead, grains of salt, a little tin, and barley bran; then covering the pot close, and carefully daubing them with clay, they put them in a furnace where they abide five days and nights together; then after a convenient time that they have stood to cool, nothing of the other matter is to be found in the pots, but only pure refined gold, some little diminished in the weight.

And thus is gold prepared in the borders of Egypt, and perfected and completed with so many and so great toils and vexations. And therefore I cannot but conclude that nature itself teaches us, that as gold is got with labour and toil, so it is kept with difficulty, creates everywhere the greatest cares, and the use of it is mixed both with pleasure and sorrow. Yet the invention of those metals is very ancient, being found out, and made use of by the ancient kings.

ASSYRIAN ENGINEERING.

Keeping Diodorus Siculus as our guide, we now come to such notes as he has left of Assyrian engineering. (Book Second.)

WALLS OF NINEVEH.

Ninus (1950 B. C.) is styled the builder of Nineveh, having provided money and treasure and other things necessary for the purpose, he built a city near the river Euphrates, very famous for its walls and fortifications, of a long form; for on both sides it ran out in length above a hundred and fifty furlongs; but the two lesser angles were only ninety furlongs a piece; so that the circumference of the whole was four hundred and fourscore furlongs. And the founder was not herein deceived, for none ever built the like, either as to the largeness of its circumference, or the stateliness of its walls; for the wall was a hundred feet in height, and so broad that three chariots might be driven together upon it abreast. There were fifteen hundred turrets upon the walls each of them two hundred feet high.

BABYLON.

Semiramis, the wife of Ninus, was the founder of Babylon. To this end having provided architects, artists, and all other necessaries for the work, she got together two millions of men out of all parts of the empire to be employed in the building of the city. It was so built that the river Euphrates ran through the middle of it, and she compassed it round with a wall of three hundred and sixty furlongs in circuit, and adorned with many stately turrets; and such was the state and grandeur of the work, that the walls were of that breadth that six chariots abreast might be driven together upon them. Their height was such as exceeded all men's belief that heard of it (as Ctesias Cnidius relates). But Clitarchus, and those who afterwards went over with Alexander into Asia, have written that the walls were in circuit three hundred and sixty-five furlongs; the queen making them of that compass, to the end that the furlongs should be as many in number as the days of the year. The walls were of brick cemented with asphalte; in height, as Ctesias says, fifty fathoms; but as some of the later writers report, but fifty cubits only, and that the breadth was but little more than what would allow two chariots to be driven afront. There were two hundred and fifty turrets in height and thickness proportionable to the largeness of the wall. It is not to be wondered at that there were so few towers upon a wall of so great circuit, seeing that in many places round the city, there were deep morasses; so that it

was judged to no purpose to raise turrets in places so naturally fortified. Between the wall and the houses there was a space left round the city of two hundred feet. That the work might be the more speedily dispatched, to each of her friends was allotted a furlong, with an allowance of all expenses necessary for their several parts, and commanded all should be finished in a year's time; which being diligently perfected to the queen's approbation, she then made a bridge over the narrowest part of the river five furlongs in length, laying the supports and pillars of the arches with great art and skill in the bottom of the water twelve feet distance from each other. That the stones might be the more firmly joined, they were bound together with hooks of iron, and the joints filled up with molten lead. And before the pillars she made defences (sterlings) with sharp pointed angles, to receive the water before it beat upon the flat sides of the pillars, which caused the course of the water to run round by degrees gently and moderately as far as to the broad sides of the pillars, so that the sharp points of the angles cut the stream, and gave a check to its violence, and the roundness of them by little and little giving way, abated the force of the current. This bridge was floored with great joists and planks of cedar, cypress and palm trees, and was thirty feet in breadth, and for art and curiosity yielded to none of the works of Semiramis. On either side of the river she raised a bank, as broad as the wall, and with great cost drew it out in length a hundred furlongs. Semiramis built likewise two palaces at each end of the bridge, upon the bank of the river, whence she might have a prospect over the whole city, and make her passage as by keys to the most convenient places in it as she had occasion. And whereas Euphrates runs through the middle of Babylon, making its course to the south, the palaces lie the one on the east, and the other on the west side of the river, both built at exceeding cost and expense. For that on the west had a high and stately wall, made of burnt brick, sixty furlongs in compass; within this was drawn another of a round form, upon which were pourtrayed in the bricks, before they were burned, all sorts of living creatures, as if it were to the life, laid with great art in curious colours. Our author goes on further to describe the ornaments of the palaces, which as less connected with our object we omit. He also describes the formation of a vaulted passage between the two palaces under the Euphrates, made by diverting the river. He says that the walls of this vault were twenty bricks in thickness, and twelve feet high, beside and above the arches; and the breadth was fifteen feet. The arches were of firm and strong brick, and plastered all over on both sides with bitumen four cubits thick. This piece of work being finished in two hundred and sixty days, the river was turned into its ancient channel again.

SEMIRAMIS'S WAY.

In a march towards Ecbatana, Semiramis arrived at the mountain Larcheum, which being many furlongs in extent, and full of steep precipices and craggy rocks, there was no passing but by long and tedious windings and turnings. To leave therefore behind her an eternal monument of her name, and to make a short cut for her passage, she caused the rocks to be hewn down, and the valleys to be filled up with earth, and so in a short time at a vast expense laid the way open and plain, which to this day is called Semiramis's way.

AQUEDUCT AT ECBATANA.

Besides this road, when she came to Ecbatana, which is situated in a low and even plain, she built there a stately palace, and bestowed more of her care and pains than she had done at any other place. For the city wanting water, (there being no spring near) she plentifully supplied it with good and wholesome water, brought thither with a great deal of toil and expense after this manner. There is a mountain called Orontes, twelve furlongs distant from the city, exceedingly high and steep for the space of five and twenty furlongs (query) up to the top; on the other side of this mountain there is a great lake which empties itself into the river. At the foot of this mountain she dug a canal fifteen feet in breadth and forty in depth, through which she conveyed water in great abundance into the city.

BRIDGE OF BOATS.

In her expedition into India, Diodorus relates that to cross the river, she carried with her boats, and made a bridge of boats by which she crossed.

SEMIRAMIS DEIFIED.

After her death or disappearance, Semiramis was adored by the Assyrians in the form of a dove, it being believed that she was enthroned among the gods.

MEMNON'S CAUSEWAY.

Of this work Diodorus gives the following account. Memnon, the son of Tithon, governor of Persia, was in the flower of his age, strong and courageous, and had built a palace in the citadel of Susa, which retained the name of Memnonia to the time of the Persian empire. He paved also there a common highway, which is called Memnon's way to this day; but the Ethiopians of Egypt question this, and say that Memnon was their countryman, and show several ancient palaces, which (they say) retain his name to this day, being called Memnon's palaces.

We shall now cull from the Fifth Book of Diodorus a number of desultory notes on different subjects, and first as to the

IRON MINES OF ETHALIA.

This island (Elba) abounds with iron stone, which they dig and cut out of the ground to melt, in order for the making of iron; much of which metal is in this sort of stone. The workmen employed first, cut the stones in pieces, and then melt them in furnaces, built and prepared for the purpose. In these furnaces, the stones by the violent heat of the fire, are melted into several pieces, in form like to great sponges, which the merchants buy by truck and exchange of other wares, and transport them to Dicearchia, and other mart towns.

TIN MINES OF BRITAIN.

Now we shall speak something of the tin which is dug and gotten here. They who inhabit the British promontory of Bolerium, by reason of their converse with merchants, are more civilized and courteous to strangers than the rest are. These are the people that make the tin, which with a great deal of care and labour they dig out of the ground; and that being rocky, the metal is mixed with some veins of earth, out of which they melt the metal, and then refine it. Then they beat it into four square pieces like to a die, and carry it to a British Isle near at hand, called Ictis (Wight).*

GOLD MINES OF GAUL—ARMS.

In Gaul there are no silver mines, but much gold, with which the nature of the place supplies the inhabitants, without the labour or toil of digging in the mines. For the winding course of the river washing with its streams the foot of the mountain, carries away great pieces of golden earth; and when it is so done, they cleanse them from the gross earthy part, by washing them in water, and then melt them in a furnace; and thus get together a vast heap of gold, with which not only the women, but the men deck and adorn themselves.

As the arms used by the Gauls are calculated to show the progress made by them in the working of other metals, we copy the following descriptions. Some carry on their shields the shapes of beasts in brass, artificially wrought, as well for defence as ornament. Upon their heads they wear helmets of brass, with large pieces of work raised upon them for ostentation sake, to be admired by the beholders; for they have either horns of the same metal joined to them, or the shape of birds and beasts carved upon them. Some of them wear iron breastplates, and hooked; but others, content with what arms nature affords them, fight naked. For swords they use a long and broad weapon called *spatha*, which they hang across their right thigh by iron or brazen chains. Some gird themselves over their coats, with belts, ornamented with gold or silver. For darts they cast those they call lances, the iron shafts of which are a cubit or more in length, and almost two hands in breadth.

CELTIBERIAN MODE OF PREPARING IRON.

They carry two edged swords exactly tempered with steel, and have daggers beside of a span long, which they make use of in close fights. They make weapons and darts in an admirable manner, for they bury plates of iron so long under ground, till the rust hath consumed the greater part, and so the rest becomes more strong and firm: of this they make their swords and other warlike weapons, and with these arms thus tempered, they so cut through every thing in their way, that neither shield, helmet, nor bone can withstand them.

SILVER MINES OF SPAIN.

Having related what concerns the Iberians, we conceive it not impertinent to say something of their silver mines; for almost all this country is full of such mines, whence is dug very good and pure silver; from which those who deal in that metal gain exceeding great profit. The Pyrenean mountains are the highest and greatest of all others, and being full of woods, and thick of trees, it is reported that in ancient time this mountainous tract was set on fire by some shepherds, and continuing burning for many days together, (whence the mountains were called Pyrenean or fiery), the parched superficies of the earth sweated abundance of silver, and the ore being melted, the metal flowed down in streams of pure silver, like a river; the use whereof

* Valso. Spain.

being unknown to the inhabitants, the Phenician merchants bought it for trifles given for it in exchange, and by transporting it into Greece, Asia and all other countries, greatly enriched themselves; and such was their covetousness, that when they had fully laden their ships, and had much more silver to bring aboard, they cut off the lead from their anchors, and made use of silver instead of the other. The Phenicians for a long time using this trade, and so growing more and more wealthy, sent many colonies into Sicily and the neighbouring islands, and at length into Africa and Sardinia; but a long time after the Iberians coming to understand the nature of the metal, sank many large mines, whence they dug an infinite quantity of pure silver, (as never was the like almost in any other place of the world), whereby they gained exceeding great wealth and revenues. The manner of working in these mines, and ordering the metal among the Iberians is thus; there being extraordinary rich mines in this country of gold, as well as of silver and brass, the labourers in the brass take a fourth part of the pure brass dug up, to their own use, and the common labourers in silver have a Euboick talent for their labour in three days time; for the whole soil is full of solid and shining ore, so that both the nature of the ground, and the industry of the workmen is admirable. At the first every common person might dig for this metal, and in regard that the silver ore was easily got, ordinary men grew very rich; but after Iberia came into the hands of the Romans, the mines were managed by a throng of Italians, whose covetousness loaded them with abundance of riches, for they bought a great number of slaves, and delivered them to the task masters and overseers of the mines. These slaves open the mouths of the mine in many places, where digging deep into the ground, are found massy clods of earth, full of gold and silver; and in sinking both in length and depth, they carry on their works in undermining the earth many furlongs distance, the workmen every way here and there making galleries under ground, and bringing up all the massy pieces of ore, (whence the profit and gain is to be had), even out of the lowest bowels of the earth. There is a great difference between these mines and those in Attica; for besides the labour, they that search there are at great cost and charge; and besides are often frustrated of their hopes, and sometimes lose what they had found, so that they seem to be unfortunate to a proverb. But those in Iberia who deal in mines, according to their expectations, are greatly enriched by their labours; for they succeed at the very first sinking, and afterwards by reason of the extraordinary richness of he soil, they find more and more resplendent veins of ore, full of gold and silver; for the whole soil round about is interlaced on every hand with these metals. Sometimes at a great depth they meet with rivers under ground, but by art give a check to the violence of their current; for by cutting of trenches under ground, they divert the stream; and being sure to gain what they aim at, when they have begun, they never leave till they have finished it; and to admiration they pump out those floods of water with those instruments called Egyptian pumps, invented by Archimedes the Syracusan, when he was in Egypt. By these with constant pumping by turns they throw up the water to the mouth of the pit, and by this means drain the mine dry, and make the place fit for their work. For this engine is so ingeniously contrived, that a vast quantity of water is strangely with little labour cast out, and the whole flux is thrown up from the very bottom to the surface of the earth. The ingenuity of the artist is justly to be admired, not only in these pumps, but in many other far greater things, for which he is famous all the world over, of which we shall distinctly give an exact enumeration, when we come to the time wherein he lived. Now though these slaves that continue as so many prisoners in these mines, incredibly enrich their masters by their labour, yet toiling night and day in these golden prisons, many of them by being over wrought, die under ground; for they have no rest or intermission from their labours; but the taskmasters by stripes force them to intolerable hardships, so that at length they die most miserably. Some that through the strength of their bodies, and vigour of their spirits are able to endure it, continue a long time in those miseries, whose calamities are such, that death to them is far more eligible than life. Since these mines afforded such wonderful riches, it may be greatly admired that none appear to have been sunk of later times; but in answer thereunto the covetousness of the Carthaginians, when they were masters of Spain, opened all.

In many places of Spain there is also found tin; but not upon the surface of the ground as some historians report, but they dig it up, and melt it down as they do gold and silver. Above Lusitania there is much of this tin metal that is in the islands lying in the ocean over against Iberia, which are therefore called Cassiterides; and much of it is likewise transported out of Britain into Gaul, the opposite continent.

(To be continued.)

HISTORICAL SKETCH ON THE USE OF BRONZE IN WORKS OF ART.

By Cesar Daly, Architect.

(Translated for the Civil Engineer and Architect's Journal from the Revue Generale de l'Architecture.)

Some years ago, many, otherwise remarkable for their learning, would ask in what degree modern civilization differed from that of ancient Greece or Rome; and even in the present day there are some who will ask the same question, even in England, in the heart of London, or of Manchester, or of Birmingham, with a thick cloud of [illegible] smoke from a hundred factories rolling in volumes over their heads. To these a feature so extraordinary, unknown to the ancients, tells no tale, though it is one which marks most strongly the character of modern times, superior in its power over physical nature, and the great development it has given to the efforts of mechanical invention. So generally, indeed, is the industrial character of modern times unnoticed, that we have scarcely any accounts of the various branches of manufactures, or of the subject generally, although this practical history is one which has the greatest interest in relation to the human race. This history in all its ramifications, whether as to the tools employed or the materials upon which they are exercised, would open a wide field of research, capable of ample gratification, notwithstanding the manner in which the records are dispersed. Among the metals and their alloys known at an early period, none has been devoted to such important uses as bronze, to which we shall devote the present essay.

Had the art of metallurgy been better known in distant periods, and the use of iron and steel more prevalent at a former epoch, or even had copper been more extensively used, we should have remained ignorant of much of the material history of antiquity, for both of the former metals disappear under the influence of rust, and copper is also a sufferer from the action of damp. Thus, while in the Portici Museum the bronze articles are well preserved, those of copper have been more or less affected, and those of iron are scarcely recognizable.

Copper was known in the earliest times, and is mentioned by Moses; but the difficulty of working it with the hammer, and the high degree of heat requisite to melt it, greatly limited its use. It was fortunately not long before the properties of a mixture of copper and tin were discovered, a mixture with greater tenacity and resistance than copper alone, fusible at a lower temperature, and denser than the mean of its components. By this mixture was obtained a metal which readily flowed into every part of the mould, so as to take a correct impress of the pattern, while it was hard enough to wear well, was not brittle, and so far from being injured by oxidation, which only affected it slightly, it was preserved by it from the action of the atmosphere, taking the beautiful colour which is so much admired. The providential discovery of these properties doubtless gave a great impulse to the infant civilization of the early stages of society, affording at the same time a greater facility for manufacture united with greater durability. Thus it came to be employed for arms and edge tools by all the nations of antiquity, whether Indians, Chinese, Egyptians and Hebrews, Greeks, Etruscans, Romans or Celts. In connexion with them, indeed, it might be well said that for many long ages bronze was the iron of the ancients. The fine arts were not long in making use of it, and we find it ministering to the decoration of many of the most ancient monuments of Egypt. In Scripture we find that the Philistines, after the capture of Sampson, loaded him with chains of brass, and Josephus relates that Solomon employed Hiram of Tyre to make two columns of bronze richly decorated, eighteen cubits high, twelve cubits in circumference, and four inches in thickness, or four times as thick as that on the Column of July. The columns were placed at the entrance of the porch of the Temple at Jerusalem. From these works we may judge that working in copper and brass was already of old date at this distant period.

We are quite in the dark as to the processes of melting and forms of the furnaces used by the ancients; but we can readily judge, from the interest, in these days of the progress of science, still attached to the casting of bronze on a large scale, of the difficulties to which workmen must have been subjected in the rude state of chemistry and metallurgy. In Greece the use of bronze was very common; the Chalciæcos, at Lacedæmon, was a temple of bronze, dedicated to Minerva, and executed about 750 years before the Christian era by the celebrated Gitiadas, poet, sculptor, and architect. Every part of this building, from the top to the bases of the columns, was entirely covered with plates of bronze decorated with mythological sculptures. Pausanias (B. 10, ch. 5,) relates that when the temple of Apollo at Delphi was rebuilt for the third time, it was constructed of copper, which is not surprising, adds he, as Acrisius had a bronze room made

for his daughter, and as there is still to be seen at Sparta the temple of Minerva Chalciæcos. He goes on further to say, "at Rome, the place in which justice is administered excites surprise by its grandeur and magnificence; but what is most admired is a bronze ceiling, which extends from one side to the other. The same author, who attributes to Theodosius and Racos of Samos the discovery of founding statues in bronze,* informs us that it was about the year 600 before our era that this art was first practised. This, like all the other arts, made great progress in the time of Pericles, but did not reach its full height until the age of Alexander, when each of the principal cities of Greece possessed several thousand figures of bronze, among which were some enormous colossi. This is what Pliny says in his 24th book, sec. 18, "There are numberless instances of boldness in this art, for we see that enormous colossal masses have been executed as large as towers. Such is the Apollo of the Capitol, brought from Apollonia, a city of Pontus, by M. Lucullus; this is thirty cubits high, and cost fifty talents. Such is the Jupiter of the Campus Martius, consecrated by the Emperor Claudius, and called Pompeian, because it is near Pompey's Theatre; such is that of Tarentum, executed by Lysippus, and which is forty cubits in height. What is most remarkable as to this figure is, that it is so well balanced that it may be moved by the hand, although it could not be upset by a whirlwind. The most admired of these colossi was that of the Sun at Rhodes, made by Chares of Lindus, a pupil of Lysippus. This figure was seventy cubits high, was overturned 56 years after its completion by an earthquake; but cast down as it is, it still excites admiration. Very few men can put their arms round the thumb, the fingers are bigger than most statues, and the hollows in the broken limbs are like the yawning mouths of caves; inside are seen stones of large size, which were used to settle it on its base. It is said to have been finished in twelve years, and to have cost three hundred talents, a sum produced by the warlike engines of King Demetrius, when he raised the siege of Rhodes. In the city are a hundred other smaller colossi, each of which would be worthy of bestowing distinction on the town in which it might be placed; besides these are five colossi of gods by Bryaxis. Italy has also produced colossi, for we see in the library of the temple of Augustus, the Tuscan Apollo, which is fifty feet high from the toe, and in which it is difficult to tell which to admire most, the bronze or the beauty of the workmanship. Spurius Carvilius had a Jupiter made for the Capitol out of the helmets, cuirasses and greaves of the conquered Samnites. The size of this statue is such that it may be seen from the place in which is the Latial Jupiter. But in our times, Zenodorus has surpassed all the figures of this kind in height, in the Mercury which he made for a city of the Gauls in Auvergne. This was ten years in execution, and cost four hundred thousand sisterces."

It is probable that these colossi were formed of a number of pieces secured with nails, like so much brazier's work, for it is thus that the ancients made their metal statues before they had acquired the art of founding. At Lillebonne in Normandy, a few years ago, in the course of the excavations for uncovering the Roman theatre, a bronze Mercury was found made in this manner. In reading the travels of Pausanias in Greece, we cannot but feel surprised at the immense number of bronze works in sculpture which he meets with at every step, particularly when we recollect that this country has been in the possession of the Romans for three centuries, and that they had already, on several occasions, carried away thousands of bronze figures. Of 33 colossi described by the tourist, 30 were of bronze, the three others of wood; he also describes 32 equestrian statues of bronze and 24 chariots, at least of natural size, sometimes with two, and oftener with four horses, and holding one or two figures. Some were accompanied by runners or grouped with men on foot who led them, in fine, he mentions more than 40 animals of considerable size, also of bronze. And yet Pausanias only visited a part of Greece. It was of bronze that the Athenians, after the death of Pisistratus, formed the first quadriga, in memory of their fellow countrymen who died while fighting for their native land. Of bronze also is constructed, in our days, the Monument of July. Bronze is, in truth, the symbol of strength, and it is interesting to observe how the same metal has been chosen, at two periods so remote, to consecrate the remembrance of facts having so much resemblance.

The Romans, as we have seen from extracts before given, made frequent use of bronze, and like the Greeks, employed it in the form of candelabræ, lamps, furniture, triclinia, altars, tripods, tools, fastenings, letters for monumental inscriptions, window fastenings, &c. The doors were sometimes plated with bronze, secured with nails of the same metal; such as those of the Pantheon. Pliny (B. 34, § 7,) says that the ancients were accustomed to make the threshold and gates of temples of bronze. Ancient gates entirely formed of bronze are still to be seen in the church of St. Cosmo and St. Damian in the Forum at Rome, formerly the temple of Romulus and Remus, and this luxury was not exclusively confined to temples, for, 380 years before our era, the ornaments were of bronze on the doors of the house of Camillus. By means of cramps large masses of bronze ornaments and carvings were fastened on monuments by way of decoration. On bronze tablets were engraved laws, treaties of peace, and public acts intended to be made known to posterity. Three thousand of these tablets were destroyed in the fire of the Capitol, in the time of Vespasian. Capitals were also made of bronze, which were secured on cores of stone. Pliny relates that "C. Octavius, who conquered Perseus in a naval action, erected, in honour of his triumph, a double portico, which was called Corinthian because the capitals of the columns were of bronze; this portico was near the Flaminian Circus; the capitals of the Pantheon, placed there by Agrippa, are of the same metal." The Romans further applied bronze in the execution of works on a large scale; the framing of the Pantheon was constructed of bronze, and, according to Serlio, who had examined it in its place, the different pieces were hollow; they were put together in the same way as woodwork. The caissons of the vault of this monument were also of bronze, and the circle which frames the opening by which the Rotunda is lighted still remains. In the baths of Caracalla the ceiling of the immense hall known as the Cella Solearis was formed of a net-work of bronze; a fact of which M. Blouet did not seem to be aware when he published his restoration of that monument. The ancients also constructed roofing of bronze, for at Rome, 212 years before the Christian era, the temple of Vesta, at Rome, was covered with tiles of bronze, and so, at a later period, was the Pantheon. As to bronze statues, there was at Rome a number truly prodigious, brought from all the great cities of Etruria, Greece, Sicily, and Asia Minor. Scaurus having erected a temporary theatre at Rome, towards the end of the republic, decorated it with three thousand of these statues.

The art of the founder naturally underwent all the vicissitudes of the other arts; in the time of Nero the decadence had already commenced, it not being possible to cast the colossal statue of that emperor, modelled by Zenodorus, and which was to have been 110 feet high,* although a century afterwards the beautiful equestrian statue of Marcus Aurelius was cast. Falconnet, in comparing these two facts, endeavours to make out a case for an attack on Pliny; but it seems to us that the circumstances may be reconciled by supposing that casting in bronze had been momentarily neglected before the time of Zenodorus, and that they had been more successfully cultivated in the time of Marcus Aurelius, for a similar circumstance happened in our own days. The brothers Keller, under Louis XIV., carried the art of casting in bronze to a high degree of perfection; but under Louis XV. the founders were not so good; and in the early part of the empire, great difficulties were met with in executing works of this kind, whilst now the art of casting in bronze has made greater progress than ever. Besides, it may be said that whenever a process is not carried on scientifically, while the reason of the different phenomena has not been discovered, and the artist consequently is reduced to take the bare results of experience for his guide, the neglect of the art for some time is enough to cause the facts to be forgotten, and the guides are consequently lost. This, however, cannot happen when the theory of an art is firmly based on scientific principles, and the reason of the phenomena is consequently understood; drawing our conclusions, from which we may say that the art of casting in bronze will henceforward never be lost, even should it be neglected for centuries; a few trials would be enough to bring it back to the point at which it had been left.

IN THE MIDDLE AGES.

During the Lower Empire, nothing remarkable was executed except some bronze gates, and the process of casting seems to have been quite lost at Constantinople. The gates of the Basilica of St. Paul, at Rome, were cast in the 11th century by Staurachios Tychitos of the isle of Chios. In the 11th century were cast those of the basilica of St. Zeno, at Verona, on which are represented passages of the Old Testament and the miracles of the saint. The bronze gates of St. Mark, at Venice, were also brought from Constantinople in the 13th century.

Germany possesses some bronze gates of the 11th century, such as those of Mentz and Augsburg. In 1330, Andrea Ugolino executed two panels for gates in bronze, from the designs of Giotto, for the Baptistry of Florence. Ghiberti finished his chef d'œuvre in 1424. In the 15th and 16th centuries several gates of bronze were cast at Venice, Padua, Bologna, Florence, Pisa, Loretto, &c.; but these works were not sufficient to prevent the art of casting in bronze from falling

* Vide B. 8, ch. 14; B. 9; B. 10, also Pliny B. 24. ch. 6.

* Pliny, B. 34, § 7. Suetonius says 120 feet.

into complete oblivion, and during almost the whole of the middle ages this art was wholly limited to casting bells.

In Modern Times.

At the Revival appeared several bronze works of art, in which Italian artists, and particularly those of the famous school of Florence, in the beginning of the 16th century, distinguished themselves most, and contributed most efficaciously in diffusing a taste for it in different European countries. The sculptor Torrigiani passed several years in England, where Henry VIII. gave him several commissions for bronze works. Primaticcio also executed, at Fontainebleau, several bronze statues from antique models which he had brought from Rome. At this time there were several French artists who were employed in brass founding; but their modes of proceeding seem to have been very imperfect, for Benvenuto Cellino relates in his memoirs that during his stay in France, he wished to cast a bronze statue of Jupiter about six feet high, which had been ordered of him by Francis I.; "but never having been engaged in this kind of work," said he, "I consulted some of the old masters of Paris, and explained to them how we managed in Italy. They replied that their manner was different, and that if I would leave it to them, they were sure to make my model in bronze such as it was in clay. I made my bargain with them; I promised them the price they asked, and even something over. I put my hand to work, but I could see well enough that they were not trying the right way. I wanted also to try myself upon a head of Julius Cæsar, larger than life, made after the model of a small head designed from a beautiful antique which I had brought from Rome. I added to it a head of the same size which I modelled from that of a beautiful girl in my service, and whom I called Fontainebleau, from the name of His Majesty's favourite palace. When I saw my furnaces finished, and our models baked, I said to my master founders, I fear that the Jupiter will not come out well, because you have not left draught enough for the air; but they replied that, if they did not succeed, they would give me my money back again, and that I should find less chance of success in the Italian method. This took place before some gentlemen whom the king often sent to see how I was getting on. Before casting the melted metal for the Jupiter, the founders wanted also to place my two heads to cast them at the same time, feeling persuaded that their mode would not succeed, and that it would be a pity to lose such fine works; but the king, who learnt it, sent to them to tell them that they must think of learning from their master, and not of teaching him. Then, smiling, they put their Jupiter in the pit, and I also arranged my two heads at the sides, and when the metal was ready, we left a free passage for it. Our moulds were quite filled, and we were all happy, I, with having succeeded in my way, and they in theirs. They asked me for something to drink, and I gave them plenty of refreshments; they then asked me to pay the sum I had promised them. You smile, said I to them, then, but I very much fear that you will cry soon; for I saw that more metal ran into the Jupiter than was wanted, and that is the reason that I shall not pay you until it is all right. These poor men felt that I was in the right, and went away without saying anything. They returned the next day very quietly to empty their pit, and began with the two heads, which were perfect; they then came to the Jupiter, which caused them to cry out, as I thought, for joy, and which made me run, but I found their faces like those of the soldiers who watched the tomb of Christ. You see, said I, what has happened to you from not believing me; you would have reaped more profit and I more honour. Learn, then, to work, and not to laugh at what is said to you. They acknowledged their error, but they regretted their time and expenses, on account of their families, whom they had to keep, and for which they should be obliged to run into debt. Never mind that, said I, I will pay you as soon as the treasurer pays me; for I pitied them, because they had worked with a good heart." Further on, telling the story about his statue of Perseus, which was also cast in bronze, he says, "The model of the Medusa, made of clay, and well-secured with iron, had already passed through the fire; I had already covered it with wax, and the bronze only was wanting. I had my furnace built directly; I took such good care, and the figure came out so clean, that my friends thought it was all done, like the French and German founders, who never finish their bronzes after they come out of the fire, being doubtless ignorant of the practice of the ancients, and many of the moderns, who finish off with a hammer and chisel." This remark of Benvenuto would lead us into the belief that the French and German bronzes contained a good deal of tin; for when the bronze contains a good deal of copper, its fusion requires a very high temperature, which vitrifies part of the sand of the mould, which, becoming attached to the figure in cooling, requires to be removed; on the other hand, a larger proportion of tin making the metal more fusible, this result was less to be feared. Benvenuto, not contented with having executed so many admirable works, left also a treatise on casting in bronze, which was long the best manual on the subject.

(To be continued.)

ON THE POWER OF THE SCREW.

Sir—There is an article by Mr. Cussen on the above subject in your number for May, on which allow me to make the following remarks.

His first objection to Mr. Bridge's formula seems to arise from a want of acquaintance with the style of mechanical language. Surely Mr. B. just meant by *d*, the pitch, or distance between the centres of the threads, or, in general, the distance between the threads, just as we talk of the length of an engine beam, when we mean its length between the end centres. Why did we not get an example from Bridges, to test his meaning of the ambiguous *d*?

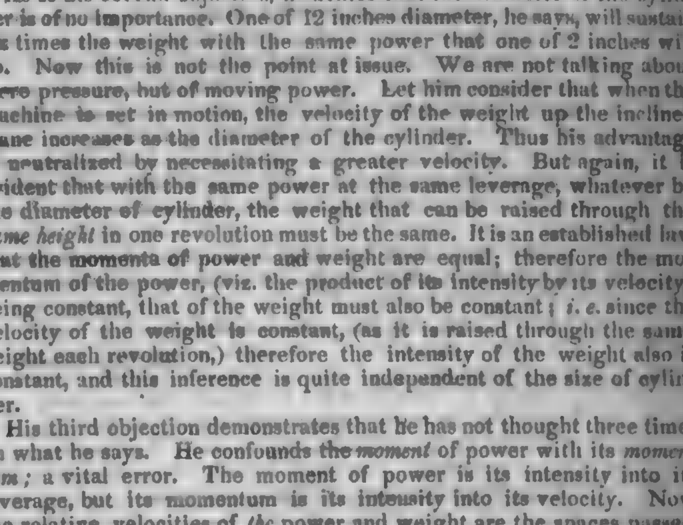
As to his second objection, he denies that the diameter of the cylinder is of no importance. One of 12 inches diameter, he says, will sustain six times the weight with the same power that one of 2 inches will do. Now this is not the point at issue. We are not talking about mere pressure, but of moving power. Let him consider that when the machine is set in motion, the velocity of the weight up the inclined plane increases as the diameter of the cylinder. Thus his advantage is neutralized by necessitating a greater velocity. But again, it is evident that with the same power at the same leverage, whatever be the diameter of cylinder, the weight that can be raised through the *same height* in one revolution must be the same. It is an established law that the momenta of power and weight are equal; therefore the momentum of the power, (viz. the product of its intensity by its velocity) being constant, that of the weight must also be constant; *i. e.* since the velocity of the weight is constant, (as it is raised through the same height each revolution,) therefore the intensity of the weight also is constant, and this inference is quite independent of the size of cylinder.

His third objection demonstrates that he has not thought three times on what he says. He confounds the *moment* of power with its *momentum*; a vital error. The moment of power is its intensity into its leverage, but its momentum is its intensity into its velocity. Now the relative velocities of *the* power and weight are the spaces passed through by each in one revolution; therefore the velocity of the latter is the pitch of the screw, and that of the former just the circumference of the circle described by its leverage. Therefore this element is chosen correctly in Bridge's formula.

ON LONG AND SHORT CONNECTING RODS.

Observing that there exists a controversy respecting long and short connecting rods, allow me to present the following demonstration of

Fig. 1. Fig. 2.



the justness of the action of all connecting rods, long or short.

Let *k e* fig. 1, be the crank end of a side lever of a marine engine, *e b* the connecting rod, and *a b* the crank moving as per arrow in the circle *b l*. The resistance at *b* acts always in the line of the connecting rod; let *e c* represent it in direction and intensity, just when the slightest overplus of power would set the engine in motion. The power acts always in the line *g e d* perpendicular to *k e*; complete the parallel-

ogram dm, then ed and dc are equivalent to ec, and these three forces are in equilibrium. Therefore, ec being the resistance, de is the power, and dc or em, the pressure on the centre k, which, as it never has motion, is of no consequence. Taking any point f in bc produced, draw fg perpendicular to it, meeting eg in g: ef and eg will express the relative virtual velocities of the resistance and power respectively, and fg, the passive *lateral* motion of the line of resistance,—passive, I say, for its direction is at right angles to this, and it is therefore of no consequence. But the triangles feg, dec, are similar, therefore $de : ec :: fe : eg$, and $de \cdot eg = fe \cdot ec$, that is, the momenta of the power and resistance are equal. The same conclusion is due at every other point in the circle bl. An addition to the power will set the engine in motion, which would be uniformly accelerated were it not that the resistance increases with the velocity. However great, then, the power may be, there will ultimately obtain a uniform motion, when the power and resistance will be in equilibrium, their momenta being equal, as before. Therefore in connecting rod motion, force for force is given and received, and there is no loss essential to that motion.

The point e of ke moves alternately in a circle. The greater limit of this angular vibration is a semicircle, in which case $ke = ab$. The smaller limit is a straight line: an indefinitely small portion of a circle, its radius ke, being indefinitely long. This limit is practically exemplified in engines in which the piston rod is at once jointed to the connecting rod, as in the annexed sketch, fig. 2, of this motion, in which ab, and be are the same as in last figure; ek the cross head, bearing perpendicularly on the slide surface lm, parallel to the piston rod he, evidently in the same way as if bearing round a centre k, infinitely distant.

Upon the whole, then, short and long connecting rods on the same length of crank must be equally effective, whatever peculiarities there be.

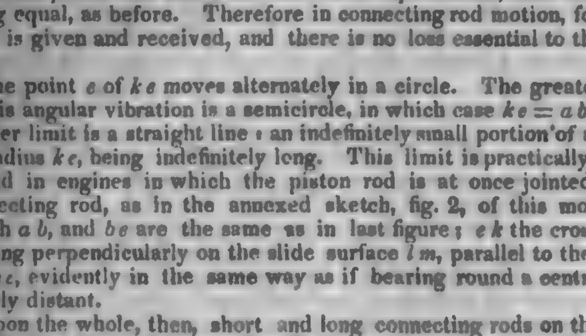
I am, Sir, your obedient servant,

DANIEL CLARK.

Phœnix Iron Works, Glasgow,
June 8, 1841.

SLOPES IN SIDELONG GROUND.

SIR—The following formula for "setting out slopes in sidelong ground," requiring the distances to be measured along the ground, and not horizontally, has, for that reason (particularly where the ground is very steep), an advantage over the formula in your last number; should you agree with me in this opinion, you will perhaps find a place for it in your next Journal.



Let $2w$ = width of the railway = AB.
$\beta = \angle$ of the slopes.
$\theta = \angle$ of the natural ground.
h = depth of cutting = CG.
Then $(w \tan \beta + F\angle) = CF$.

$$CD = (w \tan \beta + h) \frac{\sin CFD}{\sin CEF} = (w \tan \beta + h) \frac{\cos \beta}{\sin (\beta + \theta)}$$

$$CE = (w \tan \beta + h) \frac{\sin CFD}{\sin CDF} = (w \tan \beta + h) \frac{\cos \beta}{\sin (\beta - \theta)}$$

The slopes remaining constant then $w \tan \beta$ will be constant, and therefore the angle CDF will also be constant.

I am, Sir, your's most obediently,

W. R.

Manchester, June 8, 1841.

THE NELSON COLUMN.

SIR—As the Nelson column rises to view, we become sensible of what appears to be a great mistake in the *position* of it, and which ought to have been in a line drawn from the centre of the portico of the National Gallery through the Statue of Charles I., which appears as it ought to do in the centre of Whitehall; whereas the column seen from the same spot, will appear considerably to the right of the statue, and will be engaged with Drummond's Bank, the Admiralty, &c., instead of appearing to rise in the centre of the street, and thus producing a most awkward effect, whether as seen from the centre of the portico, or in approaching it as you come from Whitehall. This might easily have been avoided by placing the column in a line with the statue, which line, though not *quite* perpendicular to the plane of the portico, would have deviated from it in so very slight a degree as not to be perceptible to the eye, while the present position will produce an effect so glaringly awkward as at once to strike every beholder.—The mistake of the architect consists in having thought it necessary to place the column in a line perpendicular to the plane of the portico, whereas his object should have been to make the column appear to rise in the centre of the street, as seen from the portico which could have been done by the very slight and imperceptible deviation from the perpendicular above mentioned.

I am, Sir, your's,

ÆSTHETICUS.

ON THE THEORY OF BARS.

"Lorsque l'homme s'ecarte de la vraie cause d'un objet quelconque, il doit se considerer dans les tenebres, et il est forcé de chercher des arguments absurdes, dans lesquels il se perd, ce qui fait que les sciences deviennent ridicules dans l'opinion du vulgaire."—*Cuvier on marine deposits.*

SIR—Pursuant to the notice I gave in the last number of your valuable Journal, I take leave to send you for insertion the following observations on a "New Theory of Bars, &c., by Mr. Brooks."

The importance of the subject to this great naval and nautical nation, and to the maritime commerce of the world, should admonish us to pursue the investigation of this matter with the most cautious and serious consideration, for as it is well observed in the quotation at the head of Mr. Brooks' treatise, "our errors in this matter are of more importance than in mere objects of taste, luxury, or pleasure, because they will ever result in injury, or in the loss of some previous advantage." Let us also bear in mind Cuvier's reproof quoted above.

It does not appear requisite that I should refer to the many theories quoted by Mr. B., the controversy so prevalent at present, and in past times, in the scientific world on the subject of bars, demonstrates that it has not received that attention and examination which can lead to a right conclusion as to their cause, and what are the most eligible means to obviate the many evils incident to their existence; but I do presume that my subsequent remarks, based on facts and practical observations, will prove, that if the desideratum has not previously been developed, Mr. B. has not reflected any new light on a subject hitherto by many supposed to be enveloped in darkness.

It appears apposite to notice that Major Rennel, quoted by Mr. B., p. 1 and 2, states, "that mud and sand suspended in the waters," (*i. e.* the egress waters) "during their motion are deposited when that motion ceases, or rather they are gradually deposited as the current slackens, according to the gravity of the substance suspended;" and the late Mr. Telford gave a similar exposition. I did not expect in this age of the world, any one would reject such an evident and irrefutable fact, a principle ever in operation during the discharge of the egress tides, or currents; but Mr. B. p. 4, says, "I venture to submit, that it is insufficient," (*i. e.* the Major's thesis) "to account for the formation of bars, because the operation described (the deposit), as producing the latter (the bar), takes place in all rivers, in a greater or lesser degree, and in those which although their waters are abundantly loaded with sand or mud, are nevertheless free from bar." Mr. B. therefore disputes the accuracy of the Major's deduction, because it is the result of a partial, and not of a general law; why, Mr. B. has endeavoured to rest his entire case on local and partial data, and neglected to observe general principles.

That all rivers, harbours, bays, estuaries, &c., where the waters pass with a velocity sufficient to hold matter in suspension, have *beds* of sand, &c., is quite correct; but where the receding waters do not return or run out into the ocean with a force adequate to disturb the deposit that occurred during the quiescent state of the waters, as described by Major Rennel, there cert inly *no bar or exterior accumula-*

tion can take place; for matter does not move without an impetus. Mr. B. then *de facto*, leaves the Major's thesis (with which I agree), where he found it, based on the solid and immoveable foundation of truth.

It is quite obvious that the Major has adopted the thesis that I have, viz.

1st. That wherever rivers, sluicing, or backwaters disembogue into the ocean, either under a natural or artificial impetus, and run with sufficient velocity to hold matter in suspension, and cause a conflicting action with the waters into which they pass, there a bar is formed.

2nd. That wherever there is an absence of egress waters, currents, tides or sluicing power, and where no conflicting action ensues, there no bar exists.

3rd. That to these rules there are no exceptions throughout the world, for wherever nature is placed under similar circumstances, she is immutable in her results.

> "Here then we fix the universal cause,
> God acts by general, not by partial laws."

These primordial, universal, and indisputable facts are deduced from an extensive field of observation of many years, and on various harbours, rivers, &c., during which time I have visited the Baltic, Gulf of Finland and Bothnia, Russia, Prussia, Denmark, Sweden, Norway, Jutland, Friesland, Holland, Belgium, France, Spain, Portugal, the Mediterranean, Africa's shores, and many harbours of the united kingdom,—but all this devotion has been dealt with by Mr. Brooks in a most summary way, and to refute my theory he has used the following words, page 5, chap. 6, viz.:—"That the casual direction of the lower reach, or the position of the mouth of the river cannot truly be assigned as the cause of the existence of a bar, is easily proved by observation on rivers subject to great variations at the entrance, the bar being always found to exist independent of the direction of the discharge into the sea, this fact at once refutes the third and fourth theories."—In this extract there seems to be two distinct facts, *i. e.* the casual direction of the lower reach, and the independence of a bar, in the direction of the discharged waters, that is, he means that the deposit or bar, does not occur in the direction or course of the egress waters. With respect to Mr. B.'s assertion of the independence of the bar, of the egress waters, I have much to say, if he be correct, he has indeed "at once refuted my theory," and would prove it to be a mere visionary and hypothetical deduction; but I will proceed to show the converse, and that he has committed, as in other parts of his book, an egregious error. If the reader will turn to the author's theory, subsequently here inserted, where he uses the *wedge* to aid his illustration, and where the battle with the elements occurs at the first quarter flood, he will find it stated, "that in the conflict the sand, or other materials, which it was (*i. e.* the effluent waters), capable of holding in suspension previously to its encountering the conflicting action of the flood tide, yields it to the latter, and when this takes place the *bar is formed*;" now observe, Mr. B. tells us that the material which drops and forms the bar, is brought down into the ocean by the egress or effluent waters, that as it advances onwards, (in its own direction of course), it encounters the flood tide, and where it meets that tide there the bar is formed; so that Mr. B. himself destroys the premises which he had the boldness to adopt for the annihilation of my thesis. The positive and irresistable fact is, that all bars are formed in the direction of the effluent waters, the latter are the impetus to the matter held in suspension, and that matter must fall in the direction of the impelling power, as a shot from a gun, the ball from the foot, or the deposit from the stream of the milldam.

Passing on towards Mr. B.'s theory, I notice in chap. 2, page 19, "pier harbours which though free from bar in their natural state, are well known to become encumbered by them, on the introduction of the scouring power," here I suspect he cast his eye southward on Lowestoft Piers. Scouring power no doubt (this is my principle), causes a bar, no matter whatever way or manner it is conducted to the sea, naturally or artificially, whether there be piers or no piers.

The commencement of chapter 11 is a mere repetition of my second proposition, "That whenever a river or harbour approximates to the condition of a simple inlet for the reception of the tide it would have no bar." I endeavoured some time ago, in a conversation with Mr. B., to illustrate this truism by a reference to various harbours where the water did not pass into the sea, with a sufficient velocity to disturb the bed, there no exterior deposit could take place; no matter whether such a harbour be naturally or artificially constructed. Norway, Scotland, Ireland, Scilly Islands, Minorca, and Malta harbours, are of the first kind; Ramsgate, Margate, Scarboro', Cronstadt, Elsinore, &c., the latter.

In page 13, Mr. B. in noticing the geological features of the Yorkshire coast, says, "That a residence of some years on its shores, and a close observation enables him to state, that those seas that break on the outward platform, (the outer flat) are much heavier than those which break nearer the shore." I bear testimony to the accuracy of this fact, taught me in my boyish days by the boatmen, sailors and fishermen, that on all flat shores, or in different elevated platforms (if they must be so designated), the sea loses its force, where it is first intercepted by the shore, and as it advances and rolls up the inclined plane, so the concave dimension diminishes, till at last it finishes in a mere ripple, or tiny billow.

I have now arrived at our author's theory, and it is *multum in parvo.* "During the period of the first quarter flood, the current, in lieu of being able to take its natural upward course, as in rivers where *no bar exists*, is opposed, or effectually checked, by the effluent backwaters; the declination of the stream in the lowest division of the river presenting a head which ensures a strong downward current, long after the tide would have been able to maintain an upward course, provided the backwater had a free discharge; at this period the flood tide, by reason of its greater specific gravity, occupies the lower stratum of the tide-way, and like a wedge endeavours to force its course up the channel, which it is unable to effect, but merely elevates the lighter effluent water, the lower strata of which, being checked by the opposition of the tidal waters, yields to the latter the sand or other materials which it was capable of holding in suspension, previously to its encountering the conflicting action of the flood tide; where this takes place the bar is formed."

Having shown that Mr. B. has attempted to refute my thesis by the aid of a fallacious assertion, I now proceed to prove that he has based his own on a sandy foundation. He commences this part of his work by stating that the current, in the first quarter flood, is not able to take its natural course upwards, as in rivers where no bar exists—that is, where a bar does exist it is not able—and that this inability is occasioned by the conflicting action of the waters (and which conflicting action only exists where a bar is already formed,) and where this takes place (the conflicting action), there the bar is formed. So that, in order to sustain his "novel theory" on the cause of bars, he first must have a bar to produce the cause of a bar, and thus the effect produces the cause, and with this mode of reasoning, illogical as it is, he has attempted "at once," and with one fell swoop, *nolens volens*, to throw me overboard, and include in his general sweep, all who have attempted by principle or practice, ancient and modern, a development of the cause of bars. Mr. Brooks requires a backwater falling out of a sloping river, and that water to be opposed by a first quarter flood, and a bar itself to produce a bar; he appears not to be aware that in various parts of the world bars have accumulated where there is an entire absence of his causes, and not only at places "which approximate to the condition of a simple inlet," but where the only existing cause, amongst those which he assigns for a bar, is the egress or scouring waters; examples of which we have in the Baltic, the Black, and other seas.

In my examination before a Committee of the House of Commons in 1826-1827, on the proposed Lowestoft Harbour, I then stated "that so soon as the scouring water should be applied as then proposed, a bar would accumulate where no deposit or bar previously existed, and if the sluicing were continued the harbour would be so blocked up that small vessels only could enter at high tide." He need only refer, to prove the accuracy of his prescience, to the present state of the bar at that harbour, and the fact that about £150,000 have been expended thereon, the entire of which has been recently offered for sale by the Loan Commissioners for £17,000, it being completely lost as a harbour of refuge for which it was intended."

It is an incontrovertible fact, that the greater the quantity of egress, or sluicing waters, and the more rapid their course, the greater is the exterior deposit. The Mississippi and other large rivers demonstrate this fact—the entrance to that queen of rivers is most difficult in the spring of the year, when the melting of the snow on the mountains increases the quantity and rapidity of the egress waters, so as to carry with them trees, earth, and other matter, all of which are deposited on the extensive bar, at its outlet, and it does not again decrease until after a long continuous dry season, when the quantity of egress water is reduced.

Mr. B. follows his "new theory" by stating, "that he might easily extend his illustrations," and adds that the "direct tendency of the whole period of the ebb, when unobstructed by the tidal currents, must be to reduce the bar." This is really hypothetical. That the ebb or outgoing waters have a direct tendency, and are the real cause of all exterior deposits or bars, &c., I have asserted for the last 20 years, the accuracy of which I will now attempt to prove. At the Neva, Gulf of Finland, the Narva, Dantzic, the Danube, the Nile, and many other places, the current, without intermission (there being no *flood tide*), is perpetually running out at the rate of six, seven, or eight

knots per hour, and yet the old entrances to those rivers have been blocked up by impassable bars, and either new passages have been cut into the ocean, or the egress waters have forced a passage out in a new direction; here we have an absence of quarter flood, sloping, and of the difference in the gravity of the two waters, no salt water being in the vicinity of the disemboguing site of the above rivers.

I must now take leave to make an observation on Mr. B.'s proposition to take away the shoals or deposits in the Thames, at Woolwich by scouring, and not by dredging, the result of such an operation (if it were accomplished) would be, that the matter moved could only be impelled onward while the impetus was retained, but so soon as that ceased, a re-deposit would occur which would occupy the same extent of the bed of the river, which it had previously done—he seems not to be informed of the effect produced on Barking Shelf, removed by dredging although an immense accumulation of sand and shingle, the base of which appeared at low water—but I will not further interfere with the interior part of his subject, that is all plain sailing, no insurmountable difficulty occurs in attempts to improve inland navigation, there we have no impinging billow, or any material effect produced by the winds or tides.

Before I conclude, allow me to give some further proofs of the accuracy of my two first propositions—New Zealand, "The entrance to the bay at Wangarver is 11 miles broad, perfectly safe, and without a bar; the bay is studded with rocks, (so are the harbours I have previously referred to as being free from bar). The water is deep close to the shore. The bays of Plenby and Port Nicholson are similarly formed and are free of bar, although no back waters. The harbour of Hokiunga with an extensive interior river, where the waters run out at every ebb tide, there a bar exists. In the West Indies, at St. Lucia and the Havannah, both splendid harbours, but have neither rivers, back waters, nor bars.

I remain, Sir, your obedient servant,

HENRY BARRETT.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXVIII.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. THE absurd trifling, the stupid pedantry, the puerile discussions that at one time engaged the attention of architects, almost surpass belief, and are to be paralleled only by the quibblings of the schoolmen and divines of the dark ages, when theology was reduced to idle disputation, and religion to the practice of the grossest superstition. Were it not so authentically recorded, that it is impossible to doubt the fact, hardly would it be now believed that the problem proposed by Sansovino as to the mode of obtaining the *exact half* of a metope at the angle of a Doric entablature—the *semimetopia* of Vitruvius—made a noise throughout Italy, and excited the attention of all the architectural geniusses of the time! Had Sansovino and his contemporaries been equally scrupulous and precise in all other matters, we might excuse their overniceness in regard to such *difficiles nugæ;* instead of which they were most latitudinarian, even shamefully so in many respects. Like those people who make no difficulty of jumping over mountains, yet break their shins against straws, who can swallow millstones whole, yet are choked by a pound of butter, they were not at all shocked at some of the grossest violations of architectural propriety. In some of Sanmicheli's plans, for instance, the rooms are so frightfully out of square, that no two sides are parallel to each other. Symmetry, too, in respect to the position of doors and windows within buildings, is totally disregarded, as if it were perfectly indifferent whether it were attended to or not. The designs of Il Divino Palladio, as he has sometimes been called, abound with scandalous defects of this kind. I suspect that his "*divinity*" must have been somewhat of a piece with that of Il Divino Aretino, a monster who ought to have been hanged, drawn, and quartered. Such "divinities" as the last must be inquired for in the infernal regions.

II. Nothing can be more opposed to every legitimate principle of art and æsthetics, than the attempt to reduce the different orders to so many express and immutably fixed types. The consistency so aimed at is attended with almost the worst species of inconsistency, because it totally excludes such modification as may be most suitable for the particular case. It is time for us to get rid of all the mechanical quackery to which we have so long submitted, and which has reduced architecture, as generally practised, to little better than a mere handicraft trade—to copying certain individual parts met with in former styles of the art, without any regard either to the genius of the styles themselves, or to the circumstances of the building required. What puerile trifling it is to affect scrupulous nicety as to the express shape and proportion of every little detail belonging to columns which are to be stuck up by way of portico before a dowdy house or other building, which is thereby only rendered a grotesque absurdity! In most other matters people think of attending a little to consistency and common sense; or should they fail to do so, they must submit to the derision of their neighbours. But in architecture, the most ridiculous incongruities and *disparates* are tolerated—tolerated! they are even applauded; and *bêtises* that would hardly be endured in the preparations for a temporary fête, may be perpetrated with impunity in buildings intended to be permanent.

III. "Geniality" is not an English word,—hardly can it be said to be as yet adopted by us; and what is more to be regretted, there is, I apprehend, very little of the thing itself among the artists of this country. At all events very little evidence of it is to be discerned in our architecture. Looking at the majority of the buildings which have been erected of late years—and they certainly have not been few in number, they must be allowed to confirm such opinion, disagreeable and unflattering as it is in itself. If we find the styles respectively aimed at, copied with passable fidelity, without any particularly gross violation of their principles, it is nearly the utmost that can be said in their favour; and as matters stand, such poor negative merit must be received as a positive one. How very far, however, it stops short of geniality, hardly needs to be said, it being sufficient to remark that the latter draws out, concentrates, and heightens all the good qualities of a style, and at the same time imparts to them some fresh charm, some additional unborrowed value; and that, even though the subject should be an unpromising or inconsiderable one in itself. If he cannot always create favourable opportunities, a man of real talent will, at least, do the very utmost that circumstances will permit—will convince us that he has not satisfied himself with merely turning out a decent, workman-like job, but has applied himself to his task as to a labour of love, with the feeling of an artist, not of a builder—not of a tradesman. Were we to believe some of those who, albeit without aught of the artist in their constitution, style themselves architects, their genius would blaze forth upon the world, were but sufficient opportunities afforded them. The man who cannot put together two ideas—except detestable ones—for a moderate-sized house, or church, would be able, nevertheless—if we choose to believe him—to erect the most splendid palatial and ecclesiastical edifices. John Nash was an architect of this stamp, and as it most unfortunately happened, opportunities, both many and of no ordinary kind, were thrown in his way. How he acquitted himself of them is but too well known. It is to no purpose that Theodore Hook affects to consider him the victim of harsh and illiberal criticism; or that *Professor* Brown, as he facetiously designates himself, tells us, *ex cathedrâ*, I suppose, that John was "a man possessing great taste for the grand and the picturesque." For the GRAND! Surely the learned Professor must be speaking sneeringly and ironically, for never did Nash, on any one occasion, even approximate to the grand or the dignified in architecture. Never did he get nearer to it than 170 degrees E. or W. longitude of it. Still, incredible as it may appear, the enlightened Professor is not joking, but intends it to be taken as his serious opinion; for he elsewhere speaks of "the magnificent houses along the Strand, King William Street, and the splendid houses in the Bayswater Road!!" adding, "but when we behold the more magnificent columnar edifices on the east side of the Regent's Park, and the crescent on the west, where the houses are crowned with octagonal domes, we stand astonished with admiration!!" Most undoubtedly we do so, Mr. Professor Brown, for we stand absolutely "putrified" with astonishment that such masses of ugliness and vulgarity should ever have been erected. However, perhaps the Professor judges of Nash by his own quantum and calibre of talent and taste, in which case he has undoubtedly sufficient cause to look upon Nash as a very great man, he himself being but a mere dwarf and pigmy by the side of him, as his own designs abundantly testify. When we look upon those architectural abominations and atrocities, we do indeed stand astonished, but it is with the astonishment of unmitigated horror and disgust. Oh, Professor Brown, Professor Brown, unlucky was the day and hour when you dubbed yourself with that ambitious title. Could you get rid of it again—but no, that is impossible; it will stick to you for ever; it will render you the laughing-stock and the byword of the profession. You cannot *un-Professor* yourself now, or divorce yourself from the ill-sorted companion to which you have married your name. Doctors' Commons won't help you, Dr. Lardner will not run away with that "better-half" of you. Professor Brown

you have made yourself, and Professor Brown you must now continue to be in spite of yourself. You cannot metamorphose back again into plain Dick Brown. I pity you, I compassionate you, I condole with you—yet infinitely more do I pity and compassionate those unfortunate devils who shall imbibe their architectural taste from the designs of Professor Brown!

ARCHITECTURAL ROOM, ROYAL ACADEMY.

(Concluded from page 181.)

Having made a month's pause, we will avail ourselves of it, before we resume our own comments, to express our astonishment at an opinion we have in the interval met with, in regard to the architectural portion of the Exhibition. Either we, or the writer in the *Mirror*, is egregiously mistaken, for he tells his readers that the designs for new churches and other public buildings are "very numerous and in good taste;" whereas we think that there are rather fewer of the kind than usual, and those for the most part of very mediocre quality. In fact, it is only by referring to the catalogue and our own notes, that we can recollect above one or two, so little is there at all striking in them—except, indeed, it be by making an unfavourable impression. Such, certainly, is the case with respect to one, which is singled out by the writer in the Mirror, viz. 1059, "The Estate building at Hackney for J. B. Nichols, Esq." by J. A. Taylor, which consists only of a crowd of ugly houses detached from each other, but all *ditto*, instead of being varied as to design,—no doubt a laudable idea enough, because it saves the architect a great deal of *trouble*, without, perhaps, at all diminishing his per centage. Such architecture may do very well for the latitude of Hackney, but it is not fit to be paraded upon the walls of a Royal Academy. Or if such things must be exhibited, they must also take their chance of being somewhat cavalierly treated, since it is not every one who is so complaisant as the critic in the Mirror—a mirror, by the bye, which flatters most confoundedly.

Some may think that the Mirror's opinions are scarcely worth noticing at all, since, instead of being put into positive and tangible shape, its criticism amounts to little more than quoting from the catalogue the titles of such designs as it would recommend, and have us understand to be meritorious, without our being so unreasonable as to ask for reasons. The Art-Union—from which something better might be expected—deals in nearly the same sort of criticism, being exceedingly laconic and oracular, or, we might say, that one had need consult an oracle in order to understand upon what grounds it mentions for approbation some of the things it does—for instance, "No. 1068, Design for an Opera House, by J. C. Tinckler." We confess that that subject struck ourselves, but certainly not with admiration, the taste displayed in it, seeming to us in some respects absolutely barbarous, and what was not positively barbarous, to be no more than barely endurable. Far more readily do we agree with the Art-Union when it says, "the churches now being erected through the country, such as that at Nuneaton by Mr. T. L. Walker, seem, thanks to the Church Commissioners, to be designed by the dozen, with no better recommendation than cheapness, and no other better point about them than the certainty that they cannot last many years." As to the quality of the design thus referred to, we ourselves cannot pretend to offer an opinion, because that and about half a dozen others of the earlier numbers in the architectural section of the catalogue, are put out of sight, perhaps very deservedly so, for there certainly is nothing at all prepossessing in what can now be distinguished of them—nothing to make us particularly anxious to become more intimately acquainted with them. That a Royal Academy, not bearing the title of an Hibernian one, should persist, year after year, and in spite of repeated remonstrances, in adhering to the blundering practice of *exhibiting* drawings by hanging them where so many frames and blank paper would cover the walls—if covered they must be—quite as well, is nothing short of marvellous. If no remedy can be devised, it would at all events be but becoming and proper that the highest and tip top places should be assigned to the works of the Professor and other Academician architects; let them be exalted, and there is no doubt that they would instantly perceive and correct what they now cannot discern, viz. the gross absurdity of admitting more drawings than can be properly seen when hung up. We certainly meet with a good many whose absence would have been no loss to the exhibition; and the very first upon the list, viz. No. 956, "View of Hyde Park Gardens, Paddington," is among them, it being a subject we are sorry to see either in reality or representation—a heavy mass of bloated insignificance. No. 980, "Lonsdale Square, Islington," R. C. Carpenter, is another "flare-up" concern of the same kind. The houses that are shown may be passable enough as dwelling-houses, but as architecture they have no pretensions, nor has a drawing of this class much claim to be admitted into an academical exhibition. There are one or two designs for the Taylor and Randolph Buildings at Oxford, and we may mention that by Messrs. Mair and Browne (No. 966), as being entitled to considerable praise—as much better, in fact, than any of those for the same edifice which were exhibited last year; and it is stated to have been one of the five selected in the first instance by the committee. We should have examined it more attentively than we did at the time, had we then known as much as we now do of the design which has been adopted. We need not inform our readers that this last is by Mr. Cockerell, the Professor of architecture; but we may assure them it is by several degrees more fantastical and outré than his design for the Royal Exchange, and in some respects perfectly nondescript as to style. How the Professor—who seems ambitious of obtaining for himself the title of the English Borromini—can reconcile the *extravaganzas* he has there shown, with the precepts he delivers *ex cathedrâ*, cautioning the students against aiming at mere showy effects, rather than architectural propriety, it puzzles us to guess;—and it would, no doubt, puzzle him still more to explain.

Messrs. Gough and Roumieu's design for "St. Pancras' National Schools," (No. 976) is a small but pleasing composition, in the Tudor style, with a rather unusual degree of decoration, therefore should the building itself turn out to be as satisfactory as the drawing represents it,—which, however, is not invariably the case, it will be nearly the best thing of its kind in the metropolis. No. 1096, "Interior of the new Library at Roehampton Priory," by the same architects, is also sufficiently creditable to them; but they must excuse us for not admiring that for "St. James' Dormitory Chambers, as proposed to be erected" (No. 1080)—yet, we hope, as never will be erected. Were it not too late, we should enter a similar protest against No. 977, "An Elizabethan Villa, now building at Hammersmith, from the designs of Mr. S. Gomme," for it is a most Gommy or '*gummy*' affair, as a friend of ours would call it,—a specimen of all that is most hideous and barbarous in that style, without any of its redeeming qualities; and it would seem that the architect's aim had been rather to exaggerate than to mitigate any of its deformities. It may be excusable enough in the possessor of a genuine relique of Elizabethan architecture to be somewhat jealously proud of it—for its antiquity if for nothing else; but that at the present day any one should think of building for his own habitation a 'bran new' absurdity of the kind we here behold, is to us most marvellous.

No. 982, "New Park near Devizes, showing the principal front, with alterations and new carriage entrance," does not impress us with any very high idea of the taste or ability of Messrs. Finden and Green. How far they have doctored up the house, we know not: for aught we can tell they may have improved it, but if they have it must have been deplorably bad indeed before, since it is bad enough—we should say, intolerably bad even now.

Though we wish there were a far greater proportion of interior views than we ever meet with among the architectural drawings, we could very well have spared one of those which Mr. T. L. Walker has sent, of the "Governor's Dining Room at the new Hospital, Bedworth, Warwickshire," viz. Nos. 1014 and 1088, they being nearly duplicates, showing opposite ends of the same apartments, which although very fair as to design, is not so remarkable as to call for such an unusual degree of illustration; and we almost wonder that two drawings of the same subject should have been admitted, when others were turned away for want of room; or that, as both were received, they were not hung up together as companions. It appears, moreover, to us that either the perspective is very faulty, or else the windows themselves poor in character, owing to the excessive breadth between the mullions, according to the drawing.

No. 1027, "View of the London and Brighton Railway Terminus, now erecting at Brighton, from the designs of" D. Mocatta, is exceedingly poor both as a drawing and a design; and we are afraid he cannot shelter himself under the excuse that the subject was an unfavourable one in itself, or that he was cramped in his resources; because there is certainly enough of it as to extent, and the same degree of decoration might have been far more effectively applied. The extended colonnade below is in itself appropriate and convenient enough, but as it is made to project from the loftier mass behind it, it seems rather to encumber than to ornament it; neither is it by any means unexceptionable in regard to design. We are very far from objecting 'upon principle,' to arches being turned upon columns: on the contrary, we consider some of the instances of such combination to be among the happiest effects of Italian architecture. What we complain of is, not that such mode is here adopted, but that it is treated most insipidly, and that want of artistical feeling pervades the whole design.

At first sight we mistook No. 1056, for a view of the Parthenon or

some other Grecian Doric temple, but on referring to the catalogue discovered it to be "A project of a Curesal or Pump-room to be erected on St. Ann's Cliff, Buxton, with plans, elevations, and sections," by W. L. Granville; and there certainly are some miniature drawings on the margin, which may be the plans, &c., but which it is utterly impossible to make out at such a height above the eye; consequently all we can say is that, however ingeniously Mr. G. may have contrived the interior of his building he has not shown much invention, or particular propriety of character in the exterior of it.—We begin to get altogether sick of Grecian temples.

The "Façade of the Wesleyan Centenary Hall," No. 1058, is now exhibited as executed, the Lysicrates Monument, stuck upon it last year, being lopped off from it; which being the case we think that the frame might have been reduced also, for at present the drawing occupies twice the space the subject itself requires, and every square inch is or ought to be of value in this room.

No. 1065, "The Library, Northwood House," G. Mair, is a small interior subject that appears to deserve a more favourable situation than it has obtained. No. 1071, "Entrance Lodge to be built at Deane Park, the seat of the Earl of Cardigan," J. Crake—a name new to us—is also a clever design, in the Gothic style. We cannot say quite so much for No. 1110, "Design for a Gothic Roof in Guildhall, London," E. Woodthorpe, for though the drawing itself is a showy and elaborate interior, the new timber roof here proposed, is a poor and meagre affair. If, too, it is intended to make any alterations at all in that edifice, we think that the one most required, is to give it an entirely new exterior, the present one being so atrociously ugly that we wonder how even the corporation of London can stomach it. Taste they have, —at least have the reputation of possessing it, but it does not lie in architecture.—No. 1108, "Entrance front of a design for a Mansion to be erected at South Elkington, Lincolnshire," E. B. Lamb, is a good composition in what may be called the irregular or picturesque Italian villa style,—with a carriage porch and tower over it. While the offices are kept subordinate to the house itself, they are made to aid the general character very much, being treated consistently with it, and so as to give importance to the principal mass, and at the same time be of sufficient architectural importance in themselves. Both picturesque expression and propriety have been consulted, by introducing only a single ground floor window on this side of the body of the house: not only is great privacy thus secured, and the noise and bustle of horses and carriages shut out from the sitting rooms, but a degree of piquancy is imparted to the whole; the internal arrangement cannot be understood until we actually enter the house, which is not the case where there is a range of windows on each side of the entrance. And here we will bring our strictures to a conclusion, lest by continuing them we should be compelled to change our tone again, and have to speak not quite so favourably. Towards some our silence may be unbecoming, but there are a great many who have reason to congratulate themselves that we lay down our pen before we give them a touch of it. Very possibly we have passed over several drawings that we should have been able to notice with approbation, had they been hung where they could be seen; so long as the present system is persisted in, such is likely enough to be the case. That it is persisted in is no fault of ours: on the contrary, did it depend upon ourselves, we would correct it instanter,—if no other way, by cutting the formidable Gordian knot, and reducing the Five tiers of frames containing architectural drawings, now hung up, to Two. Three of them might very well be spared, for the quality of the Exhibition would be rather improved than not by their absence.

ON THE INJURIES TO HEALTH OCCASIONED BY BREATHING IMPURE AIR IN CLOSE APARTMENTS.

NOTWITHSTANDING the various inventions and improvements which distinguish the age we live in, it is lamentable to observe what little attention has been paid to the ventilation of apartments in which we are destined to pass the greater portion of our lives, and in which a constant and well-regulated supply of the element we breathe, is so essential to bodily health and mental enjoyment.

This inattention can only be accounted for either by the want of education in the major part of that class of persons who call themselves builders, or an apprehension on the part of those who aspire to the more elevated designation of architects, that the introduction of any thing new would expose them to the charge of a want of taste, or of that acquaintance with the style of the ancients to which it is the fashion so strictly to adhere (imitation being, in their opinions, more deserving of commendation than originality of design, or a desire to meet the improvements of the age, and fashion of more importance than health). If they construct our doors and windows in so superior a manner as to exclude every possible particle of air, they flatter themselves with having attained an advantage to which the inhabitants of ancient Greece and Rome did not aspire. They should, however recollect, in their apparent anxiety for imitation, that the ancient architects of warmer climates did not overlook the necessity of a free admission of air, and also that a constant supply and free circulation of this element, is as necessary for sustaining life as a given quantity for the combustion of the fuel we require to warm our apartments; our builders, nevertheless, only provide for the latter, as if the former, although the more important, was of minor consideration, or that they conceived the chimney draft sufficient for both purposes, when, in reality, it does not answer that for which it is principally intended—as by far the greater portion of the heat generated in our open fire-places is carried up the chimney, by sharp currents of air from occasional openings of doors, or such crevices as it may force its way through, being moreover, frequently productive of serious bodily injuries, particularly to those of delicate frames, while it cannot be sufficient for the purposes of wholesome ventilation; this air being colder than that already in the room, is consequently of greater specific gravity, and must form a lower stratum, not unfrequently felt by those placed round the fire, suffering from an undue proportion of heat at one side and of cold at the other.

It should also be borne in mind, that the openings of our fire-places being seldom more than three or four feet from the floor, the upper stratum of air is neither removed or purified by this under current, and must, from being breathed over and over again, be productive of most prejudicial effects, and that the contamination of this atmosphere is considerably augmented at night by the combustion of lights, the quantity of air breathed by an ordinary sized person being calculated to be about 2000 cubic feet per hour, and that two mould candles consume as much of the oxygen of this air as a human being, and that the nitrogen and carbonic acid gas which remain are peculiarly inimical to animal life, and that when carried up by the currents occasioned by combustion and respiration they form an upper stratum, where they remain, and must be repeatedly inspired before they make their escape into the chimney—the only ventilating flue with which our houses are provided.

It should also be observed, that the heat thus generated is in proportion to the quantity of oxygen abstracted from the atmosphere, which enters into combination with the carburetted hydrogen of the flame of candles, coal gas, oil or other inflammable matter, from which light is produced, that every cubic foot of carburetted hydrogen consumed unites on an average with two cubic feet of oxygen, that portion of the atmosphere required to support animal life, and that the product of this combustion is about 2½ inches of water, and one of carbonic acid gas, which, when inhaled in its pure state, proves instantly fatal, and the greater the proportion we inhale in addition to the animal vapours evolved from the lungs and skin, the more pernicious the effect.

Supposing for example that the perfect lighting of an ordinary sized apartment requires 15 cubic feet of carburetted hydrogen per hour, this would form about a pint and a half of water and 15 cubic feet of carbonic acid gas, for whenever carburetted hydrogen gas is burned with oxygen, or atmospheric air, these are the products of the combustion, whether the carburetted hydrogen is obtained from wax, tallow, oil, or coal. If, therefore, this lighting continue in an unventilated apartment for seven hours, one gallon of water is produced, the greater part of which must be deposited on the walls, windows, furniture, polished metal, or other cold surfaces with which it comes in contact, and to some articles of this nature it is known to prove highly prejudicial, in addition to the injury to health occasioned by an increased quantity of moisture mixed with the air we breathe—as one of the principal functions performed by this air for the preservation of health, is to carry off with it a considerable quantity of vapour in order to prevent its undue accumulation on the lungs; it is therefore evident, that after it has been already so loaded, it cannot properly perform these functions, and that consumption and other complaints are thus frequently induced.

The prejudicial effects of carbonic acid gas (which is the same as the choke damp of mines) as well as of the nitrogen of the air, which is set free by the abstraction of the oxygen, (and amounts in quantity to four times that of the oxygen,) are well known, and ought by all possible means to be provided against. This has been attended to within the last few years in our public hospitals, and the mortality, in consequence, considerably decreased, and likewise in several of our manufactories and public establishments, where the diseases generated, by the numbers of persons congregated in such establishments, have been proportionably diminished. In the House of Commons, also

where hundreds of members with hundreds of candles burning at night tended so much to vitiate the atmosphere, important improvements in lighting as well as ventilation have been recently made, but in our domestic establishments little or no attention has been paid to this important subject, and the foundation of a variety of diseases must be the result, particularly from the foul air breathed at balls or other crowded assemblies.

The confinement of air in our churches and places of public worship, must also be highly prejudicial, as we are frequently exposed on entering one of these edifices in the summer months to an atmosphere 10° or 15° below that of the external air, independent of the stagnant state in which it has been allowed to remain during a whole week—often vitiated in a greater degree by the gaseous matter evolved from human remains, and even in private houses much inconvenience is experienced from the stagnant state of the atmosphere in close and gloomy weather, an evil which has been considerably augmented by close stoves, when made of iron and heated to a certain temperature.

But if stoves were constructed of masonry throughout, as in many other countries, or of fire tiles, or porcelain plates, embedded in mortar with well-regulated flues, they would be far preferable to open fire places, this substitution of imperfect conductors of heat being not only consistent with the soundest principles of economy in the preservation of heat, and its more uniform distribution through apartments, but more salubrious than the methods usually resorted to in this country of warming air by contact with iron stoves or pipes.

The healthy appearance of those who pass the greater part of their time in the open air sufficiently indicates its advantages; armies are also well known to have far greater numbers on the sick list when well housed, than when exposed in a campaign to the vicissitudes of the season, for weeks and months without any other covering than the canopy of heaven, or occasionally of a tent or hut, or the shade of a tree. These facts ought to satisfy us that we should admit the air as freely as possible into our apartments at all seasons of the year, as the temporary and often imaginary inconvenience of a little cold, when compared with the decided disadvantages of breathing impure air, is by far the lesser evil.

When ventilation in large establishments or public buildings can only be obtained by artificial means, it is produced by pumping air in, or drawing it out by a fan worked by steam or other adequate power, and affording it the means of free circulation either cooled, heated, or in its natural state, through well-regulated apertures in the floors, walls, or ceilings, and in coal mines by flues or shafts in which constant currents of air are maintained by the combustion of fuel or coal gas; this system might also be easily introduced into houses already built, by means of the existing chimneys; but with still greater facility if our architects and builders were to direct their attention to those points when erecting new ones.

The importance of this subject has been frequently pointed out by scientific men of considerable eminence, without attracting that attention which would have been the means of rescuing many persons from being imperceptibly hurried to an untimely end. It is, therefore, to be hoped that the powerful engine of the press will continue to lend its aid in exposing these evils, until it impresses upon the public mind, and more particularly upon our architects and builders, the urgent necessity of providing against them. Is it not possible, by some simple contrivance, to make the heat produced in the lighting of apartments available for their perfect ventilation? if any of these gentlemen succeed in so doing, they will be entitled to greater gratitude for this achievement in the purification of an element so essential to the preservation of our lives, than any claimed by those heroes whose victories have contributed so much to the miseries of the human race, and the destruction of the human species.

But we ought not, perhaps, to be so much surprised at the slow march of intellect in this respect, when we find so many centuries to have elapsed before it was so generally admitted, as at present, that pure water, another element bountifully supplied by nature, is preferable to any other beverage for insuring the health and happiness of mankind, and when we have so many temperance societies and other advocates for impressing upon the minds of our fellow subjects the necessity of becoming converts to the imbibing of this element in its pure state, ought we not, with still greater reason, to endeavour to make a similar impression as to the advantages of inhaling, with equal purity, the lighter fluid, of which we stand so much more in need, and which we so much more frequently require?

A gasometer of sheet iron formed of 269 pieces, and of an immense capacity, arrived at Antwerp on the 5th instant, by the *Soho* steamer from England, intended for the gas works in that town.

REPORT FROM THE SELECT COMMITTEE ON RAILWAYS.

Our readers are aware that the 11th clause of the Railways Bill, which was for the purpose of giving discretionary powers to the Board of Trade as to the regulation of railways, excited the greatest alarm on the part of the railway boards. Sir Robert Peel was consequently induced to move for a special committee to receive evidence as to the tendency of the proposed clause. This committee has now concluded its labours, and after a lengthened investigation has made its report. The committee after stating the arguments used on both sides, sum up by recommending that the Board of Trade should not at present have the discretionary power contemplated in the 11th clause of the Bill above quoted, and prefer that the supervision of that department should be exercised in the way of suggestion rather than in that of positive regulation. This, as it will be seen wards off the blow for another year, and we hope that the railway interest will be so far instructed by this attempt, as to take better measures to oppose any future aggression of the Board of Trade.

The evidence attached to the report contains much matter of interest to which we shall be obliged to refer in a discursive manner, but before we refer to this we feel it our duty to express the obligations which the profession owes to Brunel for the able and candid way in which he gave his evidence, throwing aside all personal considerations and feelings of partiality, uninfluenced by the blandishments of the Board of Trade, and not to be deceived by its sophistries, he boldly and unscrupulously stripped the railway department of its pretensions, and exposed the incompetency and ambition of its officers. We wish that it were in our power to give equal praise to the elder Stephenson, but with the exception of the noble tribute he gave to the merits of the Great Western railway, he presented a lamentable contrast to Brunel.—Mr. Labouchere exhibited an ability in the management of his cause, which we cannot but recognize, but we must at the same time regret that it was not exerted in a better cause.

From Mr. Laing's evidence and from the documents annexed we learn some particulars as to the constitution of the Railway Department of the Board of Trade, which as it is of some importance we have thought it desirable to notice. The Department is placed like the Statistical Department in charge of Mr. Porter, and for which he receives 200*l.* per annum extra, but it does not appear that he takes any very active part.—Lieutenant-Colonel Sir Frederic Smith is Inspector General of Railways, with a salary of 900*l.* per annum and travelling expenses while engaged out of London, but without retiring allowance. The Board of Trade observes that, "the provision of the act which excludes the appointment of any one connected with railways, and the high rate of remuneration, which would be requisite to secure the undivided services of any eminent civil engineer, are of themselves sufficient to direct and almost to restrict their Lordship's choice to some officer of the Royal Engineer corps, who has a competent practical knowledge of railways." Mr. Laing transacts the official business of the Department, and is the Law and Corresponding Clerk with a salary of 500*l.* per annum.—Mr. Porter and Mr. Laing are authorized to sign all notices, documents, &c., in the name of the Board of Trade.—Mr. Oswald acts as a junior clerk. The total expense of the establishment is estimated at 1400*l.* per annum. The engineer officers employed in the first instance to assist Sir Frederic Smith, were paid two guineas a-day and expenses. The Department is put under the superintendence of the President of the Board of Trade, as consulting member of the Board. It is in contemplation that the establishment must be slightly increased.

In the evidence of the several parties who were present at the celebrated Birmingham Conference for devising the means of preventing accidents, we learn for the first time the reason that the results were so very trifling. It seems that on discussion, the difficulties that stared them in the face as to forming any general system were so great that the attempt was given up in despair, and the parties present silently acquiesced in the resolutions, which had been prepared, at the same time recommending the regulations of the Liverpool and Manchester Railway for consideration and not for adoption. Frightened as they had been by newspaper clamour—into the endeavour to adopt some measure, they were confined in their original views, that as the accidents had not arisen from neglect on the part of the companies, neither yet had they sufficient experience to devise any effective remedies.

We find also some clue to the mode of proceeding of the well known committee of three, whose activity and inactivity were the cause of so much alarm in the early part of the agitation. It appears that when the railway body, dissatisfied with their conduct, found it necessary to take the matter into their own hands, the committee thought proper to disclaim having in any degree wished to bind the

companies, a salutary step which seems to have had the best effect.—Mr. Labouchere was thus deprived of the support of this committee, whose neglect of their duties had excited so much indignation, and in place of this pliant body, he had to contend with the great railway interest, representing fifty millions of capital.

Brunel's evidence was the mainstay of the opposition, and abounds in practical information, which we wish that it was in our power to transcribe, but the limited nature of our space forbids. What he says as to engine drivers is of direct importance to the profession, and is so totally opposed to the vulgar opinion on the subject that we are compelled to insert it here.

There is another regulation suggested, and which therefore I presume is to be acted upon; it is that an engine driver shall be able to read his instructions. Now I dare say that appears to a great many gentlemen a very essential thing; but not only do I maintain that it is not essential, but I maintain that the mere laying down that rule as a rule, is a proof that the party suggesting it is not acquainted with the class of men we are dealing with, and that we must deal with, as engine drivers. I should have thought too, that Sir Frederic Smith's knowledge of the world and of military life, of privates, would have told him that the class of men who must be employed as workmen, are not a class of men who learn their instructions by reading, even if they can read; their knowledge is obtained entirely orally. A man of that class has not obtained, as we have, the power of reading and remembering what he reads. These sort of men will read and derive a little amusement from what they read, but they have not obtained the power of learning things by reading, they learn orally entirely. As to the instructions, it is true we print them, and it is true we make them read them, and we make them sign them, partly to ensure their having an opportunity to see them, but very much to satisfy the public mind when an accident has occurred; but I do not believe the men obtain the slightest knowledge of their instructions by reading; they may read them through and get up with the printed letters in their eyes, but as to obtaining information from it, they do not; they obtain their information orally; and whether a man can read his instructions or not, does not at all affect the question of his being a good engineer or not. Our very best man on the Great Western Railway, the very best engine driver we ever had; a very superior man, who is now foreman of our engineers at Reading, a man whom I trust better than anybody I have got on the line, can neither read nor write, and yet he issues instructions, and he has a clerk who writes written orders; and it would be a serious mischief if any regulation of the Legislature should deprive us of him, and of a number of others that we have. I am not one to sneer at education, but I would not give sixpence in hiring an engine man, because of his knowing how to read or write. I believe that of the two, the non-reading man is the best, and for this reason: I defy Sir Frederic Smith, or any person who has general information, and is in the habit of reading, to drive an engine. If you are going five or six miles without anything to attract attention, depend upon it you will begin thinking of something else. It is impossible that a man that indulges in reading, should make a good engine driver; it requires a species of machine, an intelligent man, an honest man, a sober man, a steady man; but I would much rather not have a thinking man. I never dare drive an engine, although I always go upon the engine; because if I go upon a bit of the line without anything to attract my attention, I begin thinking of something else. The duty of the engine man is the simplest possible thing; he must first of all have a good constitution, and be able to stand rough weather; in fact, a gentleman cannot be an engine driver, or any man who can earn a livelihood in any quiet, comfortable way; he must know something of machinery, to a very small extent; of course he must know the parts of a locomotive engine, and he must be something of a workman, although the fine workmen rarely make good engine drivers; such a very low class of knowledge of the machinery, that I can hardly call it knowledge; a mechanic learns that in a fortnight or three weeks. He must be a sober man, and have all those qualities which are included in the general term of "steady;" I hardly know how to define them; but he must be accustomed to follow orders, not desirous of infringing them; not reckless, and be what is commonly understood by "a steady man."

Sir Frederic Smith was the first witness examined, being in support of the government recommendations—what were the arguments which he used we think it unnecessary to repeat, the public being sufficiently conversant with them. He bore testimony to the harmony with which the companies and their engineers had co-operated with him, and expressed his regret at its being disturbed by the difference which had arisen on the discretionary clause—an ill omen we should say as to the result which would be likely to be realized if the clause had become the law of the land. Sir Frederic was obliged to admit that most of his proposed regulations were inapplicable as general rules, and that the greatest injustice would be the effect of their stringent execution. It must be observed that the intended legislation would have authorized the Board of Trade to interfere with the traffic in many annoying ways, as for instance on the Manchester and Leeds railway, suppressing the mixed train, disturbing the arrangements of lines generally by prescribing an interval between the trains, regulating the speed and the load, crushing small companies by overburthening them with expenses, increasing the police, breaksmen, number of breaks, buffer springs, preventing assistant engines from pushing behind, carrying luggage with passengers, obliging to work by time tables.

Mr. Booth of the Liverpool and Manchester Railway exhibited his usual acquaintance with the subject, and expressed in the strongest terms his objections to the powers proposed to be given to the Board of Trade. He unequivocally stated that he did not consider any central authority or Board competent, in the present state of knowledge as referrible to railways, to take on itself the issuing of regulations. Mr. Booth, as well as the other witnesses who followed on the same side, forcibly dwelt on the melancholy consequences which must ensue from divided responsibility, and showed the injustice of allowing the Board of Trade to make rules, and then punishing the companies for the bad working of them. For a central authority to attempt to regulate the traffic on the Liverpool and Manchester would be productive of the greatest confusion and injustice, on account of the fluctuating nature of the traffic, requiring that arrangements should be made at the moment to conform to it. In appealing against the recommendations already made by the Board of Trade authorities, Mr. Booth forcibly urged that they were such as to show that they had not that experience which is necessary to make them capable of issuing regulations, and that he could not have confidence as to their general discretion in issuing regulations. The proposed fifteen minutes interval between the trains, he showed to be equal on his line to a distance of seven miles. Mr. Booth attributed in some measure the success of the Liverpool and Manchester Railway in escaping accidents to the very great traffic, which obliged every engine driver to be constantly on the alert. Very few accidents, observed he, occur in crossing Cheapside for example; every body is obliged to be on the alert, and, to look about him.—The proposed regulation as to ballast trains he showed would be absolutely impracticable, and time tables equally useless and mischievous. The propriety of leaving the responsibility with the companies, was supported by their witnesses on the ground that they had a stronger pecuniary interest in the safety of passengers, and prevention of accidents than any other parties, and were of course urged to adopt every possible precaution. One company was mentioned as having lost £10,000 by a single accident.

Brunel, whose examination occupied two days, followed in support of Mr. Booth. To the spirit which characterized his examination we have already referred. He expressed more strongly even than Mr. Booth his want of confidence in the officers of the Board of Trade generally and individually, and throughout his examination kept Mr. Labouchere's vigilance fully on the alert, frequently discomfiting him in his attempts to entrap him into a toleration of the interference of the Board, to which Brunel objected in toto. Upon the causes of accidents, the remarks of this engineer fully bear out the views which we maintained both on this and the steam vessel question, and are well worthy of perusal.

I think the officers of the Board of Trade are under a completely erroneous impression both of the circumstances which really lead to those accidents, and of the best mode of remedying them, and that they are without, and must always be without, any sufficient knowledge of the practical working of the system with which they propose to interfere; and I think that the accidents and the suggestions arising from those accidents themselves, prove what I assert. They certainly prove it to the minds of those who are familiar with the practical working of railways. I dare say it will be difficult to prove that satisfactorily to the Committee, from the very circumstance I have just mentioned, that they are not acquainted with the practical detail of the working; but still, if the Committee will allow me, I will attempt it. I think that the mere circumstance of which the officers who have been appointed have themselves given very strong evidence, namely, that notwithstanding the tremendous speed at which railway travelling is carried on, notwithstanding the appearance of almost trusting to Providence as we run along the lines, and the apparently great risks that are run, that notwithstanding all this, it is a notorious fact, and one which is admitted by the officers who have inspected railways, that it is a safer mode of travelling than any other adopted up to the present time; and that, notwithstanding all those apparent dangers, really there is very little danger comparatively: I think that ought to have led them to consider, that, in all probability, the dangers that still exist, do not arise from any glaring prominent defects in the system, which of course those who have brought it to this state of perfection must long since have seen, and that it would hardly be left to those officers to whom the thing must be new, to discover suddenly that we have passed over some of the most prominent and easily removed causes of danger; and I think that, as they become more intimate with the practical working of railways, they will see that the real cause of danger, small as it now is, consists of a multitude of small operating causes, which occasionally and accidentally are all brought to bear, and all operate to produce risk. But the real source of the danger, and the only one which there is any hope of removing, is in a complication of imperfections in a great number of the mechanical parts of the system. We have gradually discovered, that the wheels had better be a little wider in gauge than we made them at first; that they had better not be quite so nar-

row in the external gauge; that they should be about half an inch wider on the tire; that the guard-rails had better not touch them; that increased care should be given to the gauge of the rail; and that the tail-lamps must be put in a position in which they shall be less likely to be obscured. A number of small things of that sort are gradually discovered, generally speaking, without any serious accident; they are gradually discovered and removed; and thus the original chances of risk are diminished, till, in fact, they do not occur. All those who are familiar with the working of a railway, or with the manufacture of any article, or with the progress of any complicated system of that sort, well know that it is in vain to attempt to make workmen more perfect; it is in vain to attempt to trust to any regulations in such a manner as to expect, that when a new accident occurs, they shall all apply; and that it is still more vain to expect, that they will be all obeyed. It is by gradual and progressive improvements, in all the little details, that the risk of accident is diminished; and it is by that alone that the risk of danger will be removed. This is familiar to us, and to the persons working the railways; but I am sure it cannot have struck the gentlemen who have been sent to inspect the railways; because, first of all, no looking on occasionally will make them acquainted with that which we only learn by seeing it, and feeling it, and feeling the inconvenience of it every day. They also cannot learn it, because we keep progressing so fast, that the knowledge of one day will not apply to the next; and although their own suggestions which they have made after those accidents, and although the reports which have been made by several of them show very great investigation, and a very acute perception of the circumstances, which they happened to be able to lay hold of on the ground after the accidents had occurred, still those suggestions show that they are aiming simply at that which we know cannot be attained, namely, at perfection in the regulations and in the character of the men that we have to employ, and that it is by attention to the multitude of little details alone, that approximation to perfection can be attained; that that is their view, is evident also, from the suggestions which they have all thrown out after seeing those accidents.

Mr. Brunel remarks on the application of two engines in conjunction.

All chances of collision of course are got rid of between those trains, and the average power of the whole is better obtained; although there again the necessity of understanding exactly the practical operation of the thing is evident, because it is not the case that two engines, when coupled together and drawing a load, will do twice as much as one engine. It is rather a curious circumstance, but I mean to say that the average power of the engines is best obtained by putting them together, if we take into consideration the chances of one engine running a little dry, or of any circumstance occurring to lessen the power of one engine, we do then get the average power of two or three better by sending them together than by sending them separately; and I have no hesitation in saying, that the general rule ought rather to be (though I think it would be bad to have any rule either way) to send them altogether than to send them in trains, each consisting of a single engine.

We are restricted by the space devoted to other objects from giving any greater length to the discussion of this report, and we must leave it congratulating engineers on this partial triumph, obtained at the last hour. We do sincerely trust that it will be a warning to make every exertion on the other questions that are likely to be agitated. Let a stand of this kind be made against the Ten Per Cent. Deposit Clause, let a committee be got on this question, and a relief much wanted will we hope be obtained. In concluding these remarks, we should be guilty of injustice if we did not notice the ability of Mr. Saunder's evidence, and express the great obligations the railways must entertain to Sir Robert Peel for his timely interference. The fairness shown by this statesman on this occasion will we hope prove an encouragement for obtaining a repeal of the obnoxious Ten Per Cent. Clause, as it affords a promise of our obtaining aid, if we do but show a fair case.

NEW AND USEFUL INVENTIONS.—No. 5.

By Philotechnicos.

Patent Decorative Carving and Sculpture Works, Ranelagh Road, Thames Bank, Pimlico.

This invention presents one of those great strides of machinery with which the present day abounds, for superseding manual labour in works of art as well as science. What would our forefathers have said at hearing that carving was to be done by machinery; the idea would have been considered preposterous, and the inventor, at least, a madman; but now it is almost received as a matter of course, and nothing is thought impossible; it is, moreover, most remarkable, that some of these valuable inventions are mere improvements upon simple inventions and schemes of ancient date, and familiar to nearly every one. Who would have thought that the common marking iron, used for stamping or burning the initial or name of the owner on implements of trade, should give the idea of a similar process for a more elaborate purpose—that of carving (if the term can be used) in wood? but so it is—or at least such is my anticipation from its proximity, which the reader may judge of from the description of the method adopted for the patent carving. An iron mould is first cast from a plaster or wood model. The iron mould is heated to a red heat, and applied to a piece of wood, previously damped, with great force, and repeated, until the wood is burnt to the required form. The char is then cleaned off, and any undercutting that may be required done by hand; when the operation is finished it has the appearance of old oak. The surface may be brought almost to a polish, when it assumes a highly finished appearance, nearly equal to the original, though of a first-rate master, from which it was copied. By the great pressure to which the wood is subjected, it is rendered much harder, and is consequently more secure against the action of the atmosphere or insects. The immense uses to which the patent carving can be applied must be obvious to all, and needs but little description; and will afford another opportunity —which I am always glad to give the hint of—to the "Commissioners for Building New Churches," to enliven their "interiors," which now present nothing but naked roofs, plain panelings, and any thing but gothic finishings. How does my imagination brighten at the prospect! seats, "as of old," with their beautifully carved finial standards—pulpits, paneled and moulded to richness—gallery fronts with elaborately carved tablets from scriptural subjects—the altar-piece beautifully ornamented with canopies, crockets, and finials—the roof with rich tracery, bosses, queer-looking heads, cherubim and pendants—the pew enclosures (if any, as I hope, ere long, to see the present kind, entirely abandoned, as in that neat little chapel of St. Katherine in the Regent's Park, where the body of the church contains none of those pen-like objects,) I should desire to see enlivened by the beauties of gothic carving—the communion table, chairs and enclosure, oh, what beautiful objects! elaborate to a degree; carved legs, carved backs, carved balusters—the organ, a gem, a specimen of Gibbons, with that fine, dark, brilliant polish sometimes seen in churches of the olden time. But where does my imagination lead me? were it of use to prophecy, to write, to agitate, I would do so with abundant pleasure; but I fear all the labour would be lost, all my advice thrown away, and all my time and research only wasted upon the desert air, ere they, the said Commissioners, will take the hint upon such a subject; but if they will not, surely the profession have some little influence, and will do their best to enhance the interest of our modern churches; 'tis to them I appeal, and earnestly solicit their support, in the introduction of such ornament as will display their taste and judgment, and give good scope for ingenuity. The patent carving bids fair to accomplish this, as the price—the iron ruler of all architecture—is so considerably less than that of real carving—about one third, and, in many cases, one fifth of its cost.

This invention is admirably adapted to the styles now so much in vogue, the Renaissance, Elizabethan, and Italian, the enrichments of which being so frequently repeated, make the cost of the original mould comparatively small; for upon repetition mainly depends the saving of expense. Articles of furniture are famous subjects upon which these magical operations may be performed; those old fashioned, comfortable-looking, high-backed, walnut tree chairs, with their crimson plushed seats and grotesque-looking ornaments, may be imitated to correctness. Cabinets—the pride of former days, with all their twistings and turnings, can be done with facility, and the work of years performed in as many days. It is needless to enumerate the very many purposes to which the patent process can be applied; suffice it to say, that any work carved in wood or moulded in plaster can be executed by its pyrotechnic influence, save and except the undercutting, which must be, as before stated, finished by hand. A tablet in which figures appear of cupids in high relief, is exhibited at the works, and proves full well the triumphal power of the process; and a medallion portrait of the Duke of Wellington, presented to me as a specimen, shows its use in that department.

Patent Anti-Corrosive Iron Tube Works, Brunswick Street, Blackfriars Road.

These tubes are of wrought iron tinned inside and outside, and are used for gas, steam, or water. The process renders them almost impenetrable to corrosion, and causes them to resist the action of gas or acids, for a much longer period than the common tubes; they are useful to brewers, distillers, operative chemists, and other manufacturers; and for the water companies they would be excellent, on account of the purity of the tin with which they are coated,—they are well adapted for service pipes, being less liable to burst by frost than their softer rivals.

ON THE HISTORY OF ANTIQUITIES.

SIR—The subject of the antiquities of those nations which occupied an early period of history, has frequently attracted the attention of men of learning, who have examined with the greatest care every record which could throw light on the subject of their inquiry.

These inquiries, however, have been always entered into in detached portions for the purpose of studying the history and antiquities of a single nation, and for that reason though they have been made by persons well qualified for the task, their efforts have been to a great extent fruitless, and it yet remains to collect into one focus the result of their separate labours, and by affording the opportunity for comparison to increase their value tenfold. Since the principal records of the periods to which I allude, consist in remains of the useful or liberal arts, such a comparison alone can at all exhibit the influence one nation has had on another in the progress of civilization, and enable us to connect many hitherto detached passages in the history of the arts.

No one has, perhaps, carefully compared the remains of ancient art to be found in Egypt, India, Etruria and Peru, yet we have some grounds for supposing that there has been a connection more or less close between the inhabitants of all those countries: in fact to go deeply into all these histories, by a personal examination of the principal remains, would be too arduous a task for any one individual. Besides the nations before mentioned, an attempt of this kind would embrace the history of the Chaldees, the early history of the Tartars, the Scandinavian tribes, the originators of Stonehenge, and the various constructions called Cyclopean, with the remains of now unknown origin in America, which have lately attracted the attention of the antiquaries of that continent.

Another branch of the same subject intimately connected with the former, and of which the importance is too obvious to require explanation, is that of inscriptions; and I have great reason to think that in this especially, our present ignorance arises rather from the want of a skilful combination of acquired materials, than from a deficiency in those materials themselves.

On these accounts I am ready to believe that any one entering upon this subject and fully carrying it out, (and its comprehensiveness would be its excellence), would confer an important benefit on art and literature.

I remain, &c.

E. L.

ON CONTRACTS.

SIR—I shall feel particularly obliged if you will be pleased to give your opinion, in your next publication, on the question given below, as it will be of great service in guiding me upon the business.

I remain, your most obliged,

Cardiff, May, M. R.

(CASE.)

I have been employed in making designs for a Rectory House, and afterwards a specification of the several works, and a very full detailed estimate of every item of expense of building the same, to accompany the specification. Among other things contained in the specification was the sinking of a well (that a well should be sunk to a sufficient depth to obtain water), and in the detailed estimate was an item for sinking the well of 3*l.* 10*s.*, as being informed by the Incumbent that the springs were very near the surface (which they are in the adjoining fields), and in the specification in the general condition is the following clause, that all extras, additions, or deductions made to the building shall be measured and valued according to the detailed estimate accompanying the specification. Now the site of the house is an eminence on the limestone stratum, and I have sunk a well to the depth of 78 feet below the surface, without any chance or sign of obtaining water, at an additional expense of 20*l.* over the 3*l.* 10*s.* allowed in the detailed estimate, (which sum I have not made a claim for). Through there being no water the Incumbent will not certify that the contract is fulfilled.—Please to state your opinion on the above.

[We are of opinion that from the wording of the specification alone, that the contractor has not strictly fulfilled the conditions of his contract in the eye of the law; it is one of those foolish unlimited stipulations we see too often inserted in specifications. The specification should have stated not exceeding a certain depth. However, if it can be clearly proved that the Incumbent held out to the parties tendering, that water could be procured near the surface, with a view that such parties should imagine it to be the case, and put down a price accordingly; we are then of opinion that the contractor would be relieved in equity, particularly if he proved that he had sunk the well to a reasonable depth, to show that he had used his best endeavours to procure water—which in the present case we are of opinion the contractor has done.]—EDITOR.

REVIEWS.

A Summer's Day at Windsor, and a Visit to Eton. By Edward Jesse. London, 1841. Murray.

As a guide-book or manual for the information of those who visit Windsor Castle and its immediate vicinity, this may fairly be styled a superior volume of the kind, it being tastefully got up, and containing several well-executed wood-cuts. That the subjects of the latter are well chosen, and thereby enhance the interest of the book, is more than we can add; for, with the exception of the frontispiece, which is a very useful situation's-plan of the castle, the print showing, in elevation, two bays of the exterior of St. George's chapel, another showing three ditto of the Tomb House, and one or two other cuts, the rest of the illustrations illustrate nothing. Sure we are, that had they not been given, no one would ever have missed such things as portraits of trees, facsimiles of prisoner's hand-writings, the ladies and gentlemen on horseback intended to represent Her Majesty with Melbourne & Co., or the very queer old-fashioned set-out of George III. at the Eton Montem. Of the castle itself—which it may be presumed is, after all, the principal of the lions at Windsor, nothing is shown beyond the Norman gateway—which conveys no idea whatever of the exterior generally—and St. George's Hall, and the Guard Chamber, which last is executed in a most disagreeably hard manner. Surely one or two more interiors might have been introduced; we do not say that such subjects can be furnished as cheaply as representations of stumps of old trees, &c.; we would gladly give every one of the latter for a single illustration of the other kind. While Mr. Jesse affects to entertain the highest respect for Sir Jeffry Wyatville, it is certainly no very great compliment towards that architect to keep him and his work as much in the background as possible—or, rather, to keep them quite out of sight. As regards the Castle in its present state, the letterpress is as unsatisfactory as the illustrations, there being very little indeed on the subject of the building, nothing amounting to opinion, while the description is excessively meagre; we have met with very much more from time to time in periodicals and newspapers. But the hundred and fifty pages must, of course, be filled with something, and so, indeed, they are, namely, with what has been given a hundred times before in various publications—a history of the Castle, interlarded with anecdotes as trivial as they are stale. In fact, the whole is a mere "cram,"—such a production as could have been executed by any journeyman bookseller. It is one of those things which are made to sell, for the same reason that other guide-books sell, and that court calendars find customers. But as the title-page bears a name, we naturally—and, as it now turns out, foolishly—expected to meet with something above the ordinary run of such performances. What Mr. Jesse may be as a naturalist we know not; but here he exhibits himself as a bookmaker, one of those whom Carlyle very unceremoniously calls "respectable literary thieves and paupers."

The Decorator and Artist's Assistant. Edited by J. PAGE, Author of the Acanthus.

The appearance of this periodical work is, we trust, a proof of increasing taste for design, and viewed in such a light, it meets with our best wishes. Published in weekly numbers at sixpence, and monthly parts at two shillings, it contains a variety of designs for architectural ornaments, furniture, jewellery, &c., and will no doubt be extensively patronized by the artisans to whom it is addressed. We wish that Mr. Page would in every instance give the authorities of the designs which he inserts, by which their value would be much enhanced. There is a want of boldness in the outlines, but as that is attributable to the etching, we cannot object to it.

The Acanthus.

As a homage to the architectural profession we present to their notice Mr. Page's Plate of the Acanthus, designed, drawn and engraved by himself. Mr. Page is, we believe, a self-taught artist, and we know him to be meritorious and hardworking; we hope therefore these will be claims to the patronage of the profession for which he has shown so much respect. As an object of study the luxuriant plant depicted in this engraving will well repay the student who lays out his half-crown upon it. It is a cheap and elegant ornament for the portfolio. We are informed that the drawing obtained a gold medal at the Society of Arts.

We have been obliged to defer our farther notice of Mr. Clegg's "Practical Treatise on the Manufacture and Distribution of Coal Gas," until next month.

PAPERS ON HARBOURS AND RIVERS.

Report on the navigation of the Forth. By Robert Stevenson & Sons, Civil Engineers.

Prefatory Note.—Having been called upon, by the magistrates of Stirling, to revise, with a view to its being printed, the following Report, which was made as far back as 1828, we have done so with much care. It affords us great satisfaction to be enabled to state, that the views contained in the Report have derived additional confirmation from our past experience, more especially in the case of the River Tay, whose navigation was formerly obstructed by obstacles which, although composed of different materials, closely resemble, in their position and extent, those which at present hinder the advancement of the trade of the Forth. By the partial removal of the various fords, the depth of water in the Tay, at spring tides, has been increased from 11 feet 9 inches to 16 feet; and the works, which are not yet completed, have occupied little more than two years. The hardness of the materials which compose the Fords of the Forth may render their removal more tedious; but it ought not to be forgotten, that it, at the same time, ensures greater permanency in the form of the excavated channel. It is therefore with increased confidence that we repeat the recommendations of the Report of 1828.

ROBERT STEVENSON & SONS.

Edinburgh, Dec. 10, 1838.

The Firth and River Forth are navigable for the largest class of merchant vessels, as high as the port of Alloa; and in spring tides, vessels drawing 9 feet water may proceed to Stirling, lying 10¼ miles above Alloa, while those drawing 7½ feet water, may reach the mills of Craigforth, 5 miles above Stirling. The improvement of the navigation between Alloa and Stirling, has long been regarded as a desirable object, and was brought under the notice of the Reporter by the magistrates of Stirling, in the month of November, 1825, when it was proposed to petition Parliament for leave to bring in a bill for this measure. * * *

Above Alloa the river becomes very circuitous. By the navigation the distance from thence to Stirling is 10¼ miles, while in a direct line it measures only 5 miles. It has been proposed to render the navigation of this part of the river more direct, by cutting through the links, or peninsular necks of land, for which the track of this river is so remarkable. This would shorten the navigable track; but it would have a direct tendency to deteriorate the navigation below, as a great volume of the tidal water, which at present passes over and scours the lower banks four times in the twenty-four hours, would be cut off and diverted from its course. The cutting of the links and straightening the river would also, in a material degree, interfere with the vested rights of the proprietors of the banks, by depriving some of the benefit of a water communication, and destroying the valuable salmon fisheries of others. This plan, therefore, though worthy of consideration, is, upon the whole, judged inexpedient in the existing state of things. The Reporter proposes to improve the present channel of the river by deepening it, and removing part of the numerous obstructions called Fords, and he therefore now proceeds to describe in detail each of these obstructions, and the works which are considered necessary for their removal.

Between Alloa and Stirling there are seven principal fords, or shallow parts of the river, which form so many obstructions to the navigation. It is not believed that incumbrances of a similar geological structure are to be met with in almost any other river in the kingdom. The Firths of Tay, Moray, Clyde, Solway, and the Rivers Mersey, Severn, Thames, and Humber, have their peculiar tides and difficulties, both in the form of rocks and sand banks, but none of these channels are impeded by successive chains of imbedded stones and rocks, appearing at low water, like those called the Fords of Stirling. Various hypotheses have been started to account for the existence of these fords. Some have supposed them to be artificial, arising from stones having been thrown into the shallowest parts of the river at an early period, to render it fordable for cattle. But from the minute examination which the progress of this survey has enabled the reporter to make, he has no hesitation in stating, that they are natural barriers of rock traversing the valley of the Forth, and are what geologists term *whin-dykes*, which, from the continued scouring of the bed of the river, have assumed the irregular appearance now presented by them at low water. Similar formations of whin or greenstone rock occur on the southern face of the Abbey Craig, and also on the northern side of Stirling Castle. The fords, like the cliffs at these places, consist of stones, varying in size from a cubic foot to a cubic yard, imbedded in a matrix of friable rock. The joint effect of the crooked channel of the river, and the obstructions caused by the fords, produces a great retardation in the velocity of the flood, which, in the upper parts of the river, is very sensibly less than that of the flood in the Firth, and travels at the rate of only one mile in five minutes. Although this retardation may be considered to be in part due to the operation of the river current, yet it is obvious, from its languor, that this cannot be the principal cause, and it is therefore to be sought for chiefly in the obstructions offered by the fords. On the days of new and full moon, it is high water at Alloa Pier at four hours and forty minutes; at Tullibody Pier at five hours and ten minutes; at Powis Hole at five hours and ten minutes; and at five hours and ten minutes at Stirling Shore or Quay. The consequence is, that the tide does not attain its maximum height at these three last places, until it has been ebb tide for half an hour at Alloa. It appears further, from this train of observation, that the perpendicular rise of spring tides at Alloa, is about 19 ft. 4 in.; at Tullibody, 16½ feet; at Powis Hole, 12 feet; and at Stirling, 7 ft. 8 in.: while the corresponding rise of neap tides at these stations is respectively 14½ feet, 11½ feet, 7 feet, and 3 feet. There being, therefore, a rise of 19 ft. 4 in. in spring tides at Alloa, and only 7 ft. 8 in. at Stirling, the available depth at that place is less than it would have been had there been no rise on the bed of the river, by 11 ft. 8 in. Before leaving the subject of the tides, it may be proper to remark, that the maximum point of high water at Alloa Pier is 4 inches above the level of the high water at Tullibody Pier, while it is 2 inches lower at Powis Hole, and 3½ inches higher at Stirling Shore.

The great object, therefore to which the reporter would direct the exertions of the Magistrates of Stirling, as Conservators of the Navigation of the Forth, is to the removal of the Fords, which are the chief obstructions to the free passage of the tide waters. The advantage of deepening the bottom in the upper reaches of the river is obvious, as the natural effect of such a change is to permit the tide to flow over the lowered ridges at an earlier period of the tide, and thus to allow high water to take place sooner, before the tide below may have fallen to any considerable extent; while, at the same time, an increased depth is obtained. Vessels may then start from Alloa earlier in the flood-tide, and reach the shallowest parts of the river, near Stirling, at the top of high water. In this view of the method of improving this part of the navigation, it is very satisfactory to know, that a navigable track through the whole of these obstructions may be formed at a comparatively small expense, by the common and simple process of blasting with gunpowder, and the use of flats or lighters fitted with cranes and other apparatus. The Reporter will now describe, in detail, the extent of the operations he considers necessary at the different fords.

On the reach between Alloa and Throsk, he proposes that a buoy, provided with suitable moorings, should be laid down at the seaward extremity of the bank, on the eastern side of Alloa Island, about a quarter of a mile above Alloa Pier. This buoy will be useful as a direction for avoiding an extensive spit of sand, on either side of that island. On its western side a perch or beacon is to be erected as a further guide for that channel.

The commencement of Throsk Ford is about a mile and a quarter above Alloa Pier. The channel on this ford is very shallow, and when the river is in its state of summer water, it dries nearly all the way across; but as this part of the river has the advantage of a perpendicular rise of about 18 feet in spring tides, and 13½ feet in neap tides, the navigation is comparatively little impeded. On referring to the plan and longitudinal section of the river, it will be seen, by the parts coloured red, that little excavation is proposed here. A buoy, however, is intended to be moored in a central position to show the deepest water, and, as a farther direction, a perch is to be erected on the starboard hand. This perch will also serve to point out the proper channel for passing Tullibody Island.

Cambus Ford is about a mile and a quarter above Throsk. The bottom of the channel towards the lower end of this ford consists of large stones and roots of trees, and in its upper part, large boulder stones appear above the surface at low water. The rise of tide at this ford is 16½ feet in spring tides, and 11½ feet in neap tides. The navigable channel to be cleared measures about 500 yards in length, and 30 yards in breadth at the bottom. An average cutting of one foot in depth will give about 20 feet at high water of spring tides at this place. A perch is to be erected on the larboard hand, opposite Tullibody Yare or Pier, and another on the starboard hand, to the westward of the Mouth of the Devon. By this means vessels will be enabled to avoid the foul ground at the bank on the opposite side of the river. The track of Cambus Ford is so obvious, that it is not considered necessary to moor a buoy to point out the deepest channel.

Badneath Ford is about three quarters of a mile above Cambus. Its bottom consists of two irregular lines of boulder stones, crossing the bed of the river with numerous detached masses of the same description. From the winding direction of the channel at this place, the

navigation is rendered more difficult than at either of the fords below; and, in clearing it, considerable works of excavation will be required. In spring tides the rise of the water at the lower end of this ford is 16 ft. 6 in., and at the upper end 13 ft. 4 in.; there is therefore a fall of 3 ft. 2 in., on a length of about 1150 yards, which occasions a rapid at low water, when the river is in its summer state. In neap tides, the rise is about 11 ft. 2 in. at the lower end, and 8 feet at the upper end. The length of the channel intended to be excavated at this ford is about 666 yards, and its breadth will, as already proposed, be 30 yards at the bottom. An average depth of cutting over its whole extent of about one foot will be required in order to give a depth of 18 feet at high water of spring tides. A perch is to be placed on the larboard hand at the lower end of this ford, and a buoy at the upper end. A perch must also be placed at Fallin Point on the larboard hand. In passing Polmaise and Scobbie's Pow, no difficulty occurs; near Bannockburn, however, there is a bank where a perch will be required as a direction for the deepest channel.

Manor Ford, about two miles and a quarter above Bandeath, has an irregular and stoney bottom. At the lower end of this ford, the rise in spring tides is 13 ft. 8 in., and at the upper end 12 ft. 6 in.; and in neap tides about 8 feet and 6 ft. 10 in. respectively; there is consequently a fall at low water of 14 inches which occurs on a length of 666 yards, and produces a considerable rapid at this place. The extent of ford proposed to be cleared measures about 666 yards in length, and the breadth and depth of the channel to be formed will be the same as that already specified. This will require an average cutting of 18 inches in depth. From the curved form of this channel, a perch will require to be laid down on the larboard side, for each end of the ford, and a buoy must be moored in a central position on the starboard hand.

The Sow Ford is about three quarters of a mile above the Manor Ford, the bottom is stoney and irregular, and its direction also forms a curved line, but as the bottom presents fewer obstructions to the current than the two fords immediately below, there is no visible rapid at this place. Spring tides here give a rise of 11 ft. 9 in., and neap tides 6 ft. 9 in. It will be seen, on referring to the plan and section that the works of excavation at the Sow Ford are not extensive. Instead of mooring buoys to point out the direction of the deepest water, it is proposed to erect two perches, the one on the starboard and the other upon the larboard hand. Wherever perches can be introduced they are considered preferable to buoys, which are more expensive both in their first cost and future maintenance.

The Abbey Ford is situate about a mile above the Sow Ford, and has already been excavated to a limited extent with a view to its improvement; but the excavation wants extension, both in breadth and in depth, to render it useful. The current here is still so much obstructed that it causes a considerable rapid when the river is in its summer state; the fall being no less than 2 ft. 6 in., on an extent of about 500 yards. Spring tides rise, at the lower end of this ford, 11 ft. 6 in., and at the upper end only 9 feet; and neap tides rise 6 ft. 9 in. at the bottom, and 4 ft. 3 in. at the top. The length of the excavation will be about 565 yards, with a breadth of 30 yards, similar to that of the other fords. The average depth of excavation, in order to obtain 13 feet at high water of spring tides, will be about 2 feet. Connected with this ford, two buoys are proposed to be moored on the larboard hand, the one at the lower, and the other at the upper extremity of the ford; and a perch must also be erected on the starboard hand.

The Town's Ford is situate about 500 yards above the Abbey Ford. The foul ground at this place extends about 1000 yards in length, and the works of excavation, in obtaining a navigable track, similar to that of the other fords, will be proportionally more extensive. Spring tides rise only 7 ft. 8 in. at the Town's Ford, and neap tides about 3 feet. Its bottom is very irregular and rocky, forming a great obstruction to the trade of the town, and the navigation of the upper parts of the river. The average depth of cutting at this ford will be 2 feet. For pointing out the deepest water of the new channel which it is intended to excavate, three buoys upon the larboard hand are considered necessary.

The results of the operations which the Reporter has described will be to deepen the river at those points where the obstructions occur; and the depths which are intended to be obtained at high water of spring tides are as follows at the various fords, viz.:—Throsk Ford, 22 feet; Cambus Ford, 20 feet; Bandeath Ford, 18 feet; Manor Ford, 16 feet; Sow Ford, 15 feet; Abbey Ford, 13 feet; Town's Ford, 13 feet.

By thus proportioning the depths at high water on each ford to its distance from Stirling, it is expected that vessels drawing 13 feet will have sufficient water over the lower fords at any period of flood, and will thus be enabled to reach Stirling at the very top of high water, and get the full advantage of the most favourable time of tide in the shallowest parts of the river.

The shore, or quay of Stirling, extends 200 feet or thereby along the right bank of the river, and consists of a breast-wall built in a rude manner with boulder stones, without the usual and necessary provision of defenders or wooden stretchers to prevent vessels from receiving injury while lying at their moorings. Vessels must consequently lie off in the stream to the great inconvenience of the mariner and trader. In any improvement, therefore, upon the navigation of the river, the unserviceable state of the quay-wall at Stirling should not be forgotten; but measures should be taken for rebuilding it, at least to some extent. The accommodation on this wharf is also very circumscribed and defective, but it may easily be extended and improved, as proposed to the Magistrates by the Reporter some years since. The road from the shore should also be formed on a more easy line of draught. It would likewise prove a great convenience to the southern parts of the town and the lower districts of the county, if an additional wharf, and a road from thence, were formed about the central part of the Town's Ford; as also proposed in the report above alluded to. In conclusion, the Reporter has to state as the general result of his inquiry, that it appears, from the annexed estimate, that by an expenditure of about £10,126 4s. the fords of the Forth might be cleared, so as in spring tides to admit the passage up to Stirling of the ordinary class of merchant vessels drawing about 13 feet water; and he cannot but think the importance of such an improvement far outweighs the capital required for its attainment. The position and rising importance of Stirling is too obvious to be longer neglected. It is the natural emporium of the Western Highlands, and lies in front of an extensive and fertile district, containing many valuable waterfalls and other facilities for the establishment of large manufactories.

ROBERT STEVENSON.

Abstract estimate of the probable expense of the works of excavation, mooring buoys, and erecting perches or beacons in the several fords and reaches, on the river Forth, between Alloa and Stirling, agreeably to the foregoing report.

For the expense of works of excavation and removal of stuff, and for mooring a buoy and erecting a perch connected with the reach between Alloa and Throsk, - - -	£ 72	1	0
For works of excavation, &c., at Cambus Ford -	618	18	0
For ditto ditto Bandeath Ford -	654	13	0
For ditto ditto Manor Ford -	918	7	0
For ditto ditto Sow Ford -	439	10	0
For ditto ditto Abbey Ford -	1787	16	0
For ditto ditto Town's Ford -	2747	5	0
For works of masonry and for re-building and extending Stirling Quay - - - - -	1200	0	0
	£ 8438	10	0
Incidents on the above sum of £8438 10s., at 20 per cent. - - - - - - -	1687	14	0
	£ 10,126	4	0

"ON THE IMPROVEMENT OF RIVERS, &c."

SIR—In your review last month of my Treatise on the Improvement of the Navigation of Rivers, you have given an entirely erroneous version of my views, by an unfortunate mal-arrangement of your quotations. This has possibly arisen in the press, nevertheless every scientific or practical man must feel bound, after merely reading your review, to pronounce the work quite undeserving of the approbation with which you and other literary characters have been pleased to honour it.

In chapter 2, is my definition of the regimen, or state of those rivers which are free from bars, and the plain inference to be drawn from this chapter alone must be, inasmuch as "like causes produce like effects," that we can only ensure the improvement of defective, or bar rivers, by approximating their condition to that of those which are in the required state.

In chapter 3, I give a representation of those features of the regimen, or state of bar rivers, which mark the difference between them and those which are free from bars.

In chapter 7, "*on the course to be adopted for the improvement of the depth on the bars of rivers, and in their channels,*" I state, "the reasoning in the preceding pages on the causes of the formation of bars, suggests the course to be adopted for their amelioration, by the removal of all those inner banks, or shoals, stretching like dams across

the river, which have the effect of preventing the rapid discharge of the backwater during the proper tidal duration of the ebb."

Again, "seeing that the existence of bars is to be attributed to the too great declivity of the bed of the river, or to that of its low water surface, the impropriety of forming dams across a tidal river, with the view of converting it into a line of navigation by the means of locks, ought to strike every reflecting mind as a measure which should never be adopted when there exists any possibility of obtaining the requisite depth of water by deepening the bed of the river."

In lieu of giving the above, you have merely quoted as my means of improvement, a case or exception, in which I have supposed the existence of impediments to carrying the preceding views into execution, such as the great expense of lowering a long length of rocky bed, which expense the trade of the port might not be able to bear.

Considering the error into which you have been misled, by forming your opinion upon the excepted case, in lieu of the general rule which I have advanced, I am not surprised that your views of the utility of my theory do not coincide with the favourable opinions it has elicited from other scientific quarters.

In my account of the former theories on the cause of the formation of bars, I have given the names of every author who to my knowledge has advanced upon the subject any thing beyond the opinions generally held. I did not give the name of the author of the fourth theory, because my quotation is only from a paper signed Nauticus, in the Nautical Magazine for 1837, page 487; a work much used for the diffusion of information connected with hydraulic engineering.

I perceive in your May number that Mr. Henry Barrett avows himself the author of the paper signed Nauticus.

Mr. Barrett also takes credit to himself as the originator of the suggestion of the "formation of harbours with double entrances," a principle which he says, "is now recommended by the commissioners in their report of a survey of the harbours on the south east coast." But there is no piracy of Mr. Barrett's conceptions in this, inasmuch as harbours with double entrances have been in existence for many centuries; neither is there any resemblance between the *bonâ fide* harbours of refuge proposed by the Government Commissioners to be constructed in five fathoms at low water, upon the principle of the Plymouth or Cherbourg breakwaters, and the harbours proposed by Mr. Barrett to be constructed at Dungeness, or Lowestoffe Ness; the latter being mere inland excavations, with channels of approach to them to be cut through the drifting shingle beach; but which channels and excavations are to remain for ever afterwards clear of deposit according to the theory of their projector Mr. Barrett. In my humble opinion they would speedily fill up again and become *terra firma*, notwithstanding the double entrances. Any scientific or practical man on examining Mr. Barrett's plans for harbours, will immediately perceive the error which has been made in believing that there would be any current *through* the harbour, as this could only take place if the course from one entrance to the other, *through* the harbour, were shorter than by the coast line.

In the Nautical Magazine for 1838, page 97, is a full description of Mr. Barrett's harbours of refuge, and a reply to his theories on bars. "Lowestoffe Ness is a flat point of sand and shingle, which has been slowly but continually increasing and extending further into the sea; towards the centre of this Ness it is proposed to excavate a basin of some three acres, and it is intended to open a channel north and south into the sea on either side of the Ness. These entrances being protected with short piers, and once opened to a depth of fifteen feet at low water, (no very easy job,) are thenceforth, and for ever after, so to remain at the simple *ipse dixit* of the engineer. I doubt it; I will ask any unprejudiced person acquainted with this part of the coast, the flow of tide, and the harbours in the neighbourhood, whether it is not much more likely that it will not only be barred up, but "blocked up and lost?" But Nauticus (Mr. Barrett) says, "The sole cause of bars at the mouths of harbours is the conflicting action of effluent currents passing into the ocean at *right angles* with the shore," and in reference to this theory of Mr. Barrett, and his subsequent statement that "there is no exception to this rule to be found on the whole surface of the globe," Investigator quietly observes, "assertion is not argument, nor a reference to the maps of the world, demonstration on such a point." Investigator also calls upon Nauticus (Mr. Barrett) for the names of the scientific men who he states are converts to his theories. In Mr. Barrett's letter of the 25th ult., to give weight to his statements he also adds, "numbering as I do among converts to my *thesis*, some of the most eminent scientific and practical men of the day;" and again, in reference to his theory, "I state this from observation of more than twenty years made on harbours and bars on various parts of Europe and in Africa." Now, Mr. Editor, I repeat with Investigator, that it would be far more satisfactory to be able to reason upon facts produced by Mr. Barrett, in lieu of loose statements, and the shadows of opponents. Without troubling Mr. Barrett to give us an account of the rivers on the coast of Africa, (though by the bye I have lately seen that an attempt has been made to get rid of the bar of the Kowie River, by giving the latter a direction at right angles into the sea, in lieu of its old oblique course, which by Mr. Barrett's theory ought not to have been attended with a bar), I will merely ask if my information be correct as to the statement, that the river Yare (with which Mr. Barrett is locally well acquainted) is now made to discharge its waters at right angles into the sea, and that the depth on its bar is much greater than at any known former period; or when it discharged its waters into the sea with an acute angle with the shore, when the navigation was nearly lost, and the inhabitants had to cut a direct channel through the dunes into the sea.

I am your obedient servant,

W. A. Brooks.

Stockton-on-Tees, June 1841.

KENT, THE ARCHITECT.

Sir—While I quite agree with Mr. East in regard to Kent's merits as an architect, I cannot help regretting that he should have slurred them over—at least, have passed over them so lightly without at all dwelling upon them, or even mentioning by name, a single building by him. I am rather surprised too, that while speaking of Kent, Mr. E. should not have taken Mr. Allan Cunningham to task, for the supercilious and even contemptous tone in which he has expressed himself of one who deservedly ranked so high in his day both as an architect and landscape gardener, in which last capacity he may be considered the father of the so-called English style of laying out pleasure grounds. A just tribute to his memory, in that character, has been paid to him by the writer of a paper on the subject of ornamental gardening in the Foreign Quarterly; of Kent's abilities as a painter, perhaps, the less that is said the better, but Holkham alone, would suffice for his architectural reputation, for though susceptible of improvement in some respects, it is incontestably one of the most complete residences in the kingdom,—a perfect model in regard to internal arrangement and convenience, and likewise elegance of style, and variety of effect. Every part of the plan is carefully studied, and every apartment is beautifully finished. Though by no means aiming at architectural decoration, the statue gallery is one of the most charming rooms I ever beheld,—of a beauty actually fascinating, and the view from the octagon tribune at either end affords a most striking scenic effect. Never have I seen a single plan of Palladio's which at all approaches that of Holkham, or I may say, which is not more or less disfigured by glaring blemishes and defects. Nevertheless, Cunningham makes no scruple of saying: "little interest attaches to a controversy about such a design: it is heavy and monotonous, and stamped with all the faults, which were many; and all the beauties which were few, of him who proudly wrote himself 'Painter, Sculptor, and Architect.'"—No doubt this is a neatly turned, antithetically pointed sentence; yet it is ungenerous and unjust; particularly when it is considered what an immense stride forward Kent took, from the clumsy and monotonous arrangements which had till then prevailed in the mode of laying out houses of that description.

Such being the case, I am surprised that Mr. East should not have instanced Holkham, as being the noblest work of its class and period in our architecture of the last century. That he is not sparing of admiration towards Kent is evident enough; but at the same time he has expressed himself in such general—or rather such exceedingly vague terms, that it is hardly possible to make out any definite meaning. Nay, he almost seems to deny Kent one of his chief merits, when he talks of his being an artist rather than an architect, since the princely residence above-mentioned is one pre-eminently marked by excellence of plan, and other strictly architectural qualities. Or shall I say that Holkham did not occur to Mr. E.'s recollection when he was writing his more florid than perspicuous eulogium? If unacquainted with what Arthur Young says of Holkham, he will doubtless thank me for pointing out to him that writer, whose Tours, though professedly agricultural, contain a very great deal also of interesting matter, relative to the mansions and seats be visited in different parts of the country,—far more indeed than is to be obtained from others who have confined their attention to buildings and collections of pictures. I may also here mention a paper exclusively on the subject of Holkham, in the fifth volume of Elmes' Annals of the Fine Arts, which may be recommended as an able piece of architectural criticism.

I remain, &c.

Z.

CANDIDUS *versus* S. L.

WHEN S. L. spoke of my making so free with the Professor of Architecture, it certainly looked very much as if he thought it rather a piece of presumption on my part to make any animadversions at all on opinions delivered from such an authoritative quarter. Nevertheless he now professes to wonder where I find any expression of his that seems to discountenance discussion of the opinions of public men,—in which light, I presume, the Professor of Architecture at the Royal Academy may fairly be considered, in regard to his own art, although he is not a public character in the political world. Whether it be with regard to these last alone that S. L. is ready to allow "the roughest handling," I know not; but he might perhaps have spared himself the qualifying proviso, viz., "if it be kept within the bounds of truth and reason," because it would be exceedingly difficult indeed to ascertain and lay down those bounds in a clear and satisfactory manner. I myself, for instance, should say that I did not in the slightest degree transgress them. Or, "by keeping within the bounds of truth and reason," are we to understand that we are at liberty to say only just as much and no more than will be approved of, and allowed to be perfectly reasonable, by the party animadverted upon, or by those who take just the same side of the question? In such case, I most assuredly have on many occasions shown myself to be an outrageously unreasonable sort of person;—I hope I ever shall continue to do so.

To come to something more tangible,—S. L. says he cannot see the propriety of adopting the mode suggested for Gothic windows; yet to most other persons I think it must be obvious enough, because all the objections—and I will add reasonable ones—against glazing with small *quarrels* or panes set in lead, are removed at once, and still the beauty and character of the style, as regards moulded mullions, and tracery, fully preserved. Such window may very properly be compared to an open screen,—and wherever placed, a screen of that kind may, I conceived, be described as *open*, in contradistinction from one with solid panels—though filled in with glass.

When he talks of Gothic being objected to by most persons on the score of its interfering too much with comfort, if it is to be properly treated, I must confess I do not understand him; because if "properly" treated, that style may be made to conduce quite as much to comfort and even to luxurious refinement, as any other; that is provided it be treated not only "properly" in regard to the elements and details of the style, but ably and intelligently, so as at the same time to secure all those improvements in domestic architecture we are now familiar with.—As for fac-similes of old halls and manor houses, I would leave them to such fac-simile people as would relish a Gothic dinner off the wooden trenchers of the good old times. Most assuredly, George IV., who was supposed to be as studious of personal comfort and convenience as any gentleman need be, was not one of the persons alluded to by S. L.; otherwise he would have had modern sash windows put into all the private apartments of Windsor Castle.

S. L. still insists that *invention* is the *object* of the architect when he employs either the Grecian or Roman style, though he allows—perhaps upon downright compulsion, that originality is not always the result. Nevertheless it would certainly appear that *direct imitation* is not generally aimed at; or shall we say that the numerous modern copies of ancient porticos we have beheld of late years, are so many proofs of invention though unluckily no originality has ensued from it? As for the originality of St. Stephen's, Walbrook—I am S. L.'s most humble servant, but he really must excuse my admiring it. I am aware that to extol it, is perfectly orthodox; yet it never was my doxy, nor was it that of Dr. Anderson, who has given it the "roughest handling" imaginable in his Essay. With regard again to the spire of Bow Church, I admit it to be original enough—as unlike any thing in classical architecture as possible; still it is no favourite of mine; nor is it worthy of being put into competition with that of St. George's, Bloomsbury, which last I will boldly assert to be by far the finest composition of the kind in the metropolis—I might say in England; nor am I altogether solitary in this opinion, having heard nearly the same opinion of it expressed by several professional men. I am asked, however, if I can point out any modern Gothic building possessing as much originality as the two examples quoted for my edification by S. L., I therefore say that the design for the New Houses of Parliament, displays quite as much originality, and of a far better kind, and would also refer to Cossey Hall, and Harlaxton as being highly satisfactory specimens of modern buildings, in which the Gothic has been treated with originality *con amore*. The hardest charge of all against me remains to be answered: I am quite regardless, it seems, of decency in the choice of my expressions—I believe I was once so indecorous as to write at full length, the naughty word "breeches-pocket," and I may possibly on some other occasions, have expressed myself with rather more energy than decorum; but I am not conscious of having ever made use of any expressions of which a gentleman would be ashamed, although of many that would shock those demure, hypocritical persons who are choice indeed as to their words, and seldom further than mere words. However, if S. L. can show up my indecencies and indecorums, he is perfectly at liberty to do so; and then I shall understand better than I now do, in what they consist. For my own part I have no great fancy for the milk-and-water style of writing, nor do I think it at all calculated to operate efficaciously. Did I consider architects to be infants, I should prepare and administer my doses accordingly; whereas there are many it would require a Sixty-Candidus power in order to make any impression upon them. Dainty drawing-room phrases are therefore quite out of the question: to use them—pshaw! it would be like trying to tickle a rhinoceros with a rose-leaf.

CANDIDUS.

DESIGNS WANTED.

SIR—In the *Times* newspaper of to-day (June 4th) is an advertisement inviting architects to send in designs for a Corn-Exchange to be erected at Sudbury, in Suffolk, the drawings for which are to be sent in on the 10th; so that barely three days altogether are allowed for making them, and not even that, unless a person chooses to go entirely by guess, without writing to the secretary (at Sudbury) for further particulars, or rather, for particulars, no other information being supplied by the advertisement than that there will be an area of 78 by 50 feet, yet whether that is the extent of the whole site, or merely of the part of the building appropriated to the Exchange itself, does not very clearly appear.

Surely the people who insert such advertisements must suppose that architects keep a stock of ready-made designs by them, suited for every occasion; or perhaps they may imagine that architectural designs can now be manufactured by steam, and perhaps we shall next be told that the required drawings are expected to be sent down by return of coach or train.

Undoubtedly, if an architect be pricked on with a golden spur, he will be stimulated to extra exertion. But on this occasion, the golden spur has been hammered so very thin, that it is as light as a feather. Hardly, perhaps, will you believe me when I say, that the two premiums amount together to the *extraordinary* sum, as it may very properly be called, of EIGHT GUINEAS! viz. Five for the first, and Three for the second! The man who would nibble at such a bait, would nibble the cheese put as a bait upon a mouse-trap. Leaving the preposterous shortness of time allowed out of the question, no professional man, I conceive, would pay attention to such an invitation, stamped as it is with excessive paltriness on the very face of it. Therefore, if responded to at all, it is likely to be so only by junior clerks and office assistants. It might be imagined that so gross a practical blunder as that of affording no time whatever for at all considering the subject—hardly sufficient, indeed, for putting down the first rough ideas upon paper—would not be committed by even the most ignorant. Nevertheless, such we find to be frequently the case, and what is more, that the profession itself makes no effort to put an end to it. One way would be to show up and make an example of every case of the kind. And I would further suggest, that the Institute ought to keep an exact register of all competitions advertised in the public papers, and of their respective particulars and conditions. But, unfortunately, the Institute does not seem disposed to bestir itself in earnest or to the purpose on any one occasion. It seems to be not only without the power, but without the slightest inclination, to effect any good, either for the art itself, or for those who follow it.

I remain, &c.,
ANTI-HUMBUG.

New Steamer at Brighton.—We learn from Brighton that a new steamer built at North Shields for a company at Brighton, and fitted with Mr. Smith's patent screw propeller, on the plan of the Archimedes, arrived at the Chain Pier, on Tuesday morning, from the river Tyne, after the remarkable quick passage of 48½ hours. This vessel is intended to ply from Brighton to the adjacent ports, and to be occasionally used as a tug in towing vessels in and out of Shoreham Harbour. She is about 110 tons, with engines of 45-horse power.

Steam Communication between Dresden and Prague.—The first steam boat that ever made the passage between Dresden and Prague arrived from the latter city on the 30th ult. She is called the Bohemia, and was built expressly for that service, being flat-bottomed, having 121 feet in length, and 13 ft. 6 in. in breadth. Her engine is of 40-horse power, and she is capable of carrying 40 passengers, and a considerable quantity of merchandise. When laden with a full freight she draws only 16½ inches of water, and makes the passage in about 16 hours. She is to travel to and from the two cities every three days.

NEW INVENTIONS AND IMPROVEMENTS.

STEAM ENGINE FURNACES.

EXPERIMENTS ON THE ECONOMICAL EFFECTS OF FURNACES OF DIFFERENT CONSTRUCTION, AND ON DIFFERENT KINDS OF FUEL.

These experiments have been made by a committee appointed by the Society of Industry of the Grand Duchy of Hesse, and their object has been,

1st. To ascertain the useful and economical results of furnaces for boilers constructed on different principles.

2nd. To establish the relative value of the combustibles most generally used in the country.

We do not consider it necessary to enter into the details of the experiment; we will only mention the results.

In order to decide the first question, a common boiler was set over a furnace of brickwork provided with a chimney, and this apparatus for heating was submitted to various modifications, as regarded the form and structure of the hearth as well as the disposition of the flues.

In order to resolve the second question, experimental trial was made of good dry wood chopped from the beech tree; of good coal from Roer, called *Fettschrot;* and of square pieces of turf from Greisheimer, perfectly dried, and of the heaviest kind.

The different modifications used in the construction of the furnace were the following:

I. Furnaces without flues or draught chimneys, the boiler being suspended freely above the fire.

II. A simple flue passing round the boiler, the bottom part of which only was immediately exposed to contact with the fire burning in the grate.

III. A double flue, that is, a flue going twice round the boiler in the same direction.

IV. A stove arched in the shape of a cupola, and having an opening in the middle of the arch, which became gradually wider towards the top, and by which the heat ascended, and was communicated to the bottom of the boiler, to be afterwards conveyed by three holes, placed at regular distances, into a circular passage which surrounded the boiler; to issue thence through three similar apertures differently arranged, and which communicated with a second passage placed higher, whence the draught was at length conducted into the chimney.

V. Two half flues, that is, each of which did not extend beyond half the circumference of the division of the boiler. The fore part of the flame (on the side next the door) ascended from the stove, and was distributed half into the flue on the right, half into the flue on the left, and was finally conducted into the chimney at the point where they met.

VI. Four half flues, or two on each side the boiler (from right to left); the flame issuing from the side opposite the door entered into the lower flue, then passed half the circumference of the partition of the boiler, and entered into the upper flue, whence it was finally conducted into the chimney.

The relative effects of these different arrangements have been ascertained, both with respect to the quantity of water evaporated in the boiler, as well as that of the combustible employed; particular care being taken to keep up the same level in the boiler after each experiment.

In the following table, which contains results of the experiments, the numerals indicate the different methods of construction of the furnaces in the order in which they have been described above; the figures placed underneath indicate the relative qualities of the combustibles employed to obtain a similar result; consequently the greater amounts indicate the worst methods of employing combustibles :—

Wood	VI	V	III	II	IV	I
	63	68·8	68·69	72·19	72·23	100
Turf...........	VI	III	IV	V	II	I
	53	66	71	72	76	100
Coal...........	III	IV	II	V	IV	I
	73	76	83	85	91	100

The following are the conclusions to be deduced from the foregoing table:

1. The fire over which the boiler was placed without flues was attended with a less advantageous use of combustible than those with flues.

2. The utility of flues is much more perceptible in fires of wood or turf than in coal fires, because the result is a saving in fuel of about one-fourth to one-third with wood, and almost of one-fourth to one-half with turf, and only of one-tenth to one-fourth with coal, by the addition of flues.

3. The mode of construction with four half flues (No. VI.) may be considered to be generally the most advantageous. Next to this the construction with a double flue (No. III), which in its mode of action bears the nearest resemblance to it. With respect to the arrangements Nos. II., IV., V., the effects they produce are nearly similar.

4. The double flue (No. III), which surrounds the whole boiler, is attended with better results than the single flue (No. II); according to the same principle, four half flues (No. VI) are attended with better results than two half flues (No. V).

5. With the fire of wood and of turf, two half flues (No. V) have more effect than a whole flue (No. II), and four half flues (No. VI) more than two whole flues (No. III); in short, flues which encircle only half the boiler are in this case more effectual; while with a coal fire it is precisely the contrary. The cause of the difference is doubtless this, that in such combustibles as wood or turf, which blaze brightly, a retardation of the heated air, which in these half flues produces a sudden change in the direction of its motion, is more advantageous than with coal.

With respect to the calorific power of the different fuels, there results from equal weights of turf, 96, and of coal, 250, when that of wood is considered equal to 100.

The great difference that is found in combustibles, with respect to their natural quality and their composition, as well as in their degrees of dryness, can scarcely admit of forming points of comparison between these latter results and any other given case. It is well known that there are turfs which from an equal weight throw out more heat than wood; but the results with respect to the different methods of constructing furnaces are more to be depended on; because in these are remarked a degree of regularity in their effects, and it is easy to account for the causes on which the differences depend.—*Moniteur Industriel.—Inventor's Advocate.*

LOCOMOTIVE EXCAVATOR.

This French machine is stated to be the invention of M. Gervais, of Caen. The trial of the apparatus was made in the presence of a committee of the Society of Emulation at Rouen, and of many of the distinguished residents of the town, and the result is said to have left no doubt of the possibility of making excavations by the power of steam. It is said to be particularly applicable in digging canals, and making the excavations for railways. The apparatus is placed on a large heavy kind of carriage, in the fore part of which there is a steam-engine of six horse power, with oscillating cylinders and a tubular boiler, which works the machine, and also turns the two fore wheels very slowly, so that the whole is gradually moved forward as the work progresses, large pieces of wood being laid down to form temporary rails over which the machine is propelled. Towards the back of the machine there are two machines similar to dragging machines, which raise the earth that has been dug out, and deposit it in a horizontal endless chain of buckets, which carry the excavated earth beyond the limits of the trench, and there deposit it, forming an even and regular bank on each side. The excavating apparatus is placed about the middle of the carriage. It consists of four iron shafts parallel to each other and equi-distant, the whole four having their axes in the same plane, and forming an angle of fifty degrees to the horizon, the incline being towards the back of the machine. Each shaft has attached to it five double arms, equi-distant from the bottom to the top, and each arm is furnished with a spade-shaped tool. These shafts, therefore, present forty spades working at different heights, which dig a ditch nearly three metres in width and upwards of one metre in depth. Each of these excavating tools when in action strikes against the earth ten times in a minute. These revolving excavating shafts are put in motion by the steam-engine, and the action of the engine is so regulated that the whole machine progresses at the rate of about twelve metres an hour. The whole of the machinery, including the carriage, weighs about 24,000 kilogrammes, or 15 tons. When, owing to the nature of the soil or the presence of large stones, the action of the tools is resisted, the locomotion is stopped, and the whole apparatus is made to back, so as to enable men to remove the obstruction. The trenches dug by this machine are very exact, the sides are perpendicular and smooth, and the earth thrown out forms on each side a regular embankment. A machine of this kind was some time since shown by M. Gervais to the French Academy of Sciences, on which they reported very favourably, but it was not provided with the means of locomotion, nor was it on so large a scale as the machine at Rouen. *Ibid.*

CALOTYPE.

It has been known for some time, that Mr. Fox Talbot, in the progress of his experiments to render more perfect the art of photogenic drawing, had discovered a means by which paper could be made far more sensitive to light than heretofore. The impressions, however, so quickly obtained by this new method, are in the first instance *invisible*, but by a process similar to the first, they are made to appear with even greater power than in ordinary photogenic drawing. On Thursday evening, June 10, Mr. Talbot read a paper at the Royal Society, in which he described the new process, called, for distinction's sake, *Calotype*; and as the subject is one of general interest, we shall here briefly describe it :—The paper is covered with iodide of silver, by washing it successively with nitrate of silver and iodide of potassium. Afterwards it is washed over with gallo-nitrate of silver, the greater part of which is removed by immersion in water, but enough adheres to render the paper exceedingly sensitive to light. The paper is then dried, and placed in the camera obscura, and the image of a building, or other object, is generally obtained in less than a minute. This image, however, is usually quite invisible; and the mode of rendering it visible (which is the most curious part of the Calotype process,) consists in washing it again with gallo-nitrate of silver and then gently warming it, which generally causes the appearance of the picture with great force and vivacity in the space of a minute or less. The gallo-nitrate of silver is formed simply by mixing solutions of nitrate of

silver and gallic acid. The operation requires to be executed with great care and precision, but is not difficult in other respects. The theory of the process remains, at present, unexplained.—*Athenæum.*

IMPROVEMENTS IN FURNACES AND BOILERS.

Charles Wye Williams, of Liverpool, gentleman, for certain improvements in the construction of furnaces and boilers. Enrolled at the Petty Bag Office, May 17. Claim first.—The use and application of metallic pins as conductors for transmitting heat. This part of the invention consists in inserting metal pins in the plates of which boilers, evaporating pans, &c., and pipes, &c., attached to the same, are composed; part of each pin extending through the bottom of the vessel into the liquid to be heated or evaporated, and the other part projecting outside of the vessel into the fire beneath it, by which arrangement a greater quantity of heat is transmitted to the liquid than there would be by the usual method.

Claim second.—The mode of giving the longitudinal and vertical movements to the fire-bars of a furnace; also the extension of the fire-bars outside of the furnace, so as to receive fuel from a hopper, and spread it evenly over the fire-grate.

The fire-bars are serrated (the elevated parts being wedge-shaped, and the depressions quite smooth), and incline downwards from the fire-door towards the bridge of the furnace, their lower ends resting on a bar, on which they are capable of moving verticallly up and down as on a centre; the other ends terminate beneath a hopper outside of the fire-place, but within the fire-door; they are supported at this end by eccentrics placed on a horizontal shaft, which, being turned by hand, or by gearing from the steam-engine, communicates the up-and-down movements to the fire-bars, and the fuel being received from the hopper on to the outer ends of the fire-bars, is urged with a gradually diminishing force towards their inner ends, and spread evenly over the surface of the fire-grate. By the continued movements of the fire-bars the generation of clinkers is prevented.—*Inventors' Advocate.*

IMPROVED APPARATUS FOR CUTTING AND SHAPING METALS.

Joseph Whitworth, of Manchester, engineer, and John Spear, of the same place, gentleman, for certain improvements in machinery, tools, or apparatus for cutting and shaping metals, and other substances. Enrolled at the Petty Bag Office, May 17.

The first part of this invention consists of an improved die for cutting screws. The principle upon which this die is formed may be described as effecting the following object, viz. to cut a screw-thread at any required depth with dies, which have themselves been cut by a master-tap, double the depth of the thread, larger in diameter than the shaft on which the thread is to be cut. The improved die is formed from the common die, by dividing the same either into two equal parts (the plane of section being parallel to the sides of the die), or into three unequal parts, in which latter case the two planes of section are parallel with each other, but at an inclination to the sides of the die. In working this die, its plane of direction, instead of passing from the axis of the shaft on which the thread is to be cut to the centre line of the die, as in ordinary dies, passes outside of the said line. The patentee shows an improved stock, of a very simple construction, to be used with the die.

The second part of this invention is an improved mode of actuating the planing machine, described in the specification of a patent obtained by Mr. Joseph Whitworth, in 1839.

The third part of this invention consists of improvements in slotting machines, the chief feature of which is the compound moving table. This table consists of three parts, the lower part sliding along the bed of the machine; the middle part moving at right angles to the lower one; and the top one having a rotary movement communicated to it.

The fourth part is an improvement in the slotting bar. An angular groove is cut down the back of the bar to receive a strip of metal tapped for small set screws, by which the positions of the cutters are adjusted, and in the front of the bar recesses are scooped out round the cutters, to afford room for the cuttings.

The fifth part is an improvement in the slide lathe, and consists in attaching an apparatus to the headstock or mandril frame of the lathe, for the purpose of forming, together with the change-wheels, a more perfect communication between the mandril and guide-screw.

The last part consists of an apparatus for "truing up" the wheels of carriages and engines on railways. The apparatus is applied to a pair of wheels in the following manner:—one end of a connecting rod is attached by a stud to the outside bearing of each wheel below the axle, and the other ends of these rods are fastened to a horizontal bar parallel to the axle; on this bar a sliding bar composed of two parts moves, each of its outer ends being provided with a grinder or cutter, placed opposite to and in contact with the outer rim or tire of each wheel; the inner ends of this sliding bar are joined together by an eccentric pin passing through them, fastened on a horizontal wheel, which has its bearings on the under part of the horizontal bar; this wheel is turned by an endless band, from a small pulley on the axle of the running wheels. Motion being communicated to the horizontal wheel, it will, by means of the eccentric pin, cause the two parts of the sliding bar to move alternately a short space backwards and forwards, by which means the grinders on their outer ends will be caused to traverse from side to side of the tire of the wheels as they revolve, and thereby grind down any inequalities of the same.—*Ibid.*

UNIVERSAL CHUCK FOR TURNING AND BORING.

Alexander Stivens, of Manchester, engineer, for certain improvements in machinery or apparatus to be used as a universal chuck for turning and boring purposes. Enrolled at the Petty Bag Office, May 19. The patentee claims the peculiar and novel arrangement of apparatus constituting a universal chuck, without confining himself to the number, size, or dimensions of the levers working on the central boss.

The chuck is formed of two plates, viz., a front plate and a back plate, in the former of which are formed three radial mortices; the three holding nogs or dies are attached by screws to dove-tail slide-pieces, which slide backwards and forwards in the mortices. In one of these pieces a nut is formed, in which a screw works, its outer end being supported in a bearing on the edge of the front plate, so that on turning the screw round by means of a key applied to its outer end, the slide-piece will be made to traverse to and fro in its mortice. To each slide-piece is attached one end of a straight lever, the other ends of which levers are attached to an equilateral triangular lever, working loosely on the centre boss of the chuck; by this means, on the screw being turned, the slide-pieces will advance or recede simultaneously within their mortices.—*Ibid.*

IMPROVEMENTS IN DETACHING LOCOMOTIVE AND OTHER CARRIAGES.

Francis Pope, of Wolverhampton, Engineer, for improvements in detaching locomotive and other carriages. Enrollment Office, May 24. This invention consists of an ingenious piece of mechanism by which a horse can be instantly detached from the vehicle to which he is attached, or one carriage can be separated from another on railways. When applied to horse carriages, each shaft terminates in two iron side plates carrying a pin which form the axis of the shafts, and is the means by which they are attached to the carriage. There are also two side plates attached to the carriage, carrying a pin which forms the axis of motion to a bent lever or tongue; this tongue when turned back embraces the pin on the end of the shafts, and holds it securely in the recess formed for it. The tongue is held down by a peculiarly formed spring catch, to which a lever is affixed. So long as the tongue is held down by this catch, the shafts are securely held to the carriage, but on pulling the lever the catch is disengaged, the tongue flies over and the shafts and horse are released. When applied to railway carriages three of these attachments are employed, the centre one being a bar corresponding to the end of the shafts in the former case, and the two outer ones being chains. The three catches are simultaneously acted upon by an apparatus terminating in a handle which runs up to the seat of the guard. The claim is to the mode of constructing and applying apparatus as described.—*Mechanics' Magazine.*

CASE-HARDENING IRON.

Robert Roberts, of Bradford, Lancashire, Blacksmith, for a new method or process of case-hardening iron. Enrolled at the Petty Bag Office, May 25. This method consists in heating the iron and plunging it into cast iron in a state of fusion and turning it about, when it will become cased to any required thickness from $\frac{1}{16}$ to $\frac{1}{8}$ an inch, when it is to be plunged into cold water, and will then be found to be effectually case hardened. The claim is to the method or process of case-hardening iron, by coating, covering, or combining wrought iron with cast iron.—*Ibid.*

IMPROVEMENT IN PADDLE-WHEELS.

Henry Charles Daubeny, Esq., Boulogne-sur-mer, France, for a certain invention or improvement in the making and forming of paddle-wheels, for the use of vessels propelled in the water by steam or other power, and applicable to propel vessels and mills. Enrollment Office, May 25. The floats are mounted on spindles or axes, one end of which work in a box or centre, the others in the circumference of the paddle-wheel. Near the ends of the spindles which works in the box, there are short levers which work against a traverse, so as to expose their broad surface to the water, while they enter and quit it edgeways. By this feathering operation, all the inconveniences arising from back water are obviated. In order to relieve the paddles from the effects of heavy seas, they are provided with an escapement consisting of two or more cogs let into the box of the wheel, and traversing round with it in a groove provided for that purpose in the flanch or carrier, fixed on the end of the main shaft; in this groove there are bridges which cause the cogs in passing

them to throw up their front ends, and thus present their hind ends opposite to abutments formed in the face of the carrier, which, coming in contact with the hinder ends of the cogs, turn the paddle-wheel round. In the event of this wheel being struck by a heavy sea, the blow causes it to revolve faster than the carrier, and thereby relieves it from the injurious effects of the concussion. When the force of the sea is expended, the abutments again come in contact with the cogs, and the wheel is driven round by the effects of the engine. A mode of placing paddle-wheels in an inclined position is shown, by which means external projecting paddle-boxes are dispensed with.—*Ibid.*

IMPROVEMENTS IN STOPCOCKS.

Henry Bridge Cowell, of Lower-street, St. Mary's, Islington, Middlesex, ironmonger, for improvements in taps, to be used for or in the manner of stopcocks, for the purpose of drawing off and stopping the flow of fluids. Enrolled June 2, at the Roll's Chapel Office.

The first part of this invention consists in applying a moveable stopper to the spout of a tap, such stopper being suspended at the lower ends of two upright connecting links, one at each side of the spout, which link pass down through holes or sockets in the metal of the head of the tap. The upper ends of these links are connected to a piece of metal or collar, situated above the head, and fitted around a screw that turns in the same, so that on the screw being turned it will either rise or fall, and consequently raise or lower the stopper, thereby opening or shutting the spout of the tap. The fluid which escapes round the sides of the orifice of the spout on the stopper being lowered will be collected in the hollow mouth of the tap, so as to run out in a compact stream from the lower orifice.

The second part of this invention consists in applying to a ball-cock (similar in its parts to the tap just described) a second ball and lever, provided with a click or detent, having a tooth, which catches into a notch or notches cut in the circumference of an enlarged head on the end of the screw before mentioned. The click is mounted on a centre pin fixed in the collar of the screw, so that whenever the other ball descends the tooth catches into one of the notches, and turns back the screw, thereby opening the passage through the cock for the water. The usual ball is kept submerged during the flowing in of the water into the cistern, by means of the click preventing the screw to which it is attached from being turned; but when the surface of the water reaches the second ball, and raises the same upwards, the click will be lifted up about its centre of motion, so as to disengage its tooth from the notch in the head of the screw, whereupon the other ball will immediately rise to the top of the water by its power of floatation, and close the passage of the cock.

The third part of this invention consists of another kind of tap, similar in some respects to the one first described.—The moveable stopper is fitted in the manner of a piston into the cylindrical hollow of the head of the tap, so as to move up and down therein by the action of a screw working in a cap that surmounts the head of the tap; by turning this screw round, the stopper is pressed down on the upper orifice of the water-passage of the spout, and at the same time over the annular orifice of a circular channel formed within the head of the tap, and passing round the water-passage, through which channel the water is conveyed to the passage. Thus on depressing the stopper the flow of water will be stopped, but on raising the same the water will be permitted to flow again.—*Inventors' Advocate.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

February 23.—William Cubitt, V.P. in the Chair.

The following were balloted for and elected: Colonel Sir Frederick Smith, R.E., William Chadwick, John Bazley White, jun., Charles Lorimer Hensman, Joseph Whitworth, and Evan Hopkins, as Associates.

"*Description of a new mode of Steering, as applied to boats of light draught of water, navigating shallow and rapid rivers.*" By Captain Henderson, Assoc. Inst. C.E.

The ordinary method of steering with a single rudder, fixed in the usual manner, will bring a vessel round in about four times its length, upon an axis at the point of union between the dead wood of the vessel and the rudder. It was found desirable for the particular service on the Ganges and Burhampooter, for which the vessel in question was designed by the Assam Company, that great facility should be given for coming round rapidly; to accomplish this, the stem and stern of the vessel are alike provided with rudders, of a form adapted to the curvature of the craft. The stern rudder is considerably larger than the other, and occupies the space usually allotted to the dead wood, which is cut away; a more immediate influence is thus exerted upon the boat. The rudders are raised or lowered according to the draught of water, by means of capstans fixed upon the projecting ends of the shaft of a pinion, which is geared into a toothed racked of peculiar construction, on the back of each rudder post. The effect of this arrangement is, that the centre of revolution is transferred to a point nearer the centre of the vessel, and deviating from the true centre, in proportion to the relative dimensions, position and figure of the two rudders, and of the lines forward and abaft the vessel, which is thus brought round in little more than its own length.

The vessel, of which a model accompanied the paper, is fitted with condensing engines working expansively, with a pressure of steam of 20 lb. in the boiler; the cylinders are placed at an angle towards the paddle shafts, and act directly upon the cranks without the intervention of side levers.

"*Description of a Coffre Dam used in excavating Rock from the navigable Channel of the river Ribble.*" By David Stevenson.

The navigation of the river Ribble being much impeded by natural bars or weirs of sandstone rock, compact gravel, or loose sand, several ineffectual attempts were made to remove these hindrances, and eventually a joint stock company, called the Ribble Navigation Company, was formed for that purpose. Messrs. Robert Stevenson and Sons (of Edinburgh) were consulted, and under their directions the present works were commenced: their plan was to cut a channel in the rock wherever it was necessary, and to remove the gravel and sand by steam dredging, forming at the same time a low rubble wall upwards of a mile in length, for the purpose of directing the course of the river so as to obtain a permanent and straight navigable track for the shipping. The first of these operations is alone treated of in the communication.

About half a mile below Preston, a bed of sandstone rock, upwards of 300 yards in length, stretches quite across the river; some portions are entirely free from any deposit of sand or mud, and the higher parts are frequently left dry during the summer months. This natural weir exerts such an influence upon the flow of the tides, that neap tides which at 12 miles distance rise 14 feet, are not at all perceived at the quay at Preston.

It was proposed to cut a channel through this bar, 100 feet in breadth, affording an average navigable depth of 20 feet at high water of spring tides. In some places, therefore, the excavation would be 13 ft. 6 in. deep. After much consideration it was determined to make use of a series of coffre dams, as the most effectual and economical mode of proceeding. Their construction may be thus briefly described:—

A double row of wrought-iron bars, $2\frac{1}{4}$ inches diameter, with *jumper* points worked upon them, were inserted vertically into the rock at regular intervals of 3 feet apart laterally, the second row being placed 3 feet behind the front row. When a sufficient number of bars were fixed, a tier of planking, 3 inches thick, with clasps to enable the planks to be fixed to the rods, was placed withinside. The lower edges of the planks were cut out roughly to the inequalities of the rock; they were then lowered, and by means of an iron rod, with a crooked end, those parts which did not touch the bottom were ascertained, and a change in the form made, until the plank rested its whole length on the rock: the lower edge was then bevelled off, and being finally lowered to its place, the plank was beaten down by the force of a heavy mallet, upon an upright piece of wood resting upon the upper edge of the planks; the lower bevelled edge yielding to the blows, sunk into the irregularities of the rock, and thus ultimately, in connexion with the puddle behind it, formed a perfectly water-tight joint. The lower planks being fixed, the upper ones were placed upon them; transverse tie bars were inserted at intervals; and the clay puddle was formed in the usual manner. In order that the navigation of the river should not be impeded, the diagonal stays were all placed inside the dams. These stays had joints at the upper ends, and being slipped over the tops of the iron rods, and kept in their places by cotters, their lower ends could be moved either horizontally or vertically, as the irregularity of the rock required:—as the excavation proceeded, longer stays were easily substituted, by merely removing the cotter, sliding up the short stay, and replacing it by another suited to the increased depth. The sides of the dam were kept together by bars of iron connected to two horizontal wale pieces, 10 inches by 6 inches, placed on the outside of the vertical iron rods. When the dam was thus constructed, the water was pumped out by a steam engine of 10 horses power, with two pumps of 12 inches diameter.

The whole of the excavation, which was 300 yards in length, and 100 feet in width, was to be completed with three lengths of coffre dams, so contrived as to include within the second stretch the lower side of the first dam, in order to excavate the rock in which that row of piles was fixed. The first and second lengths have been most successfully executed; the third is now in progress, and the excavation is proceeding very rapidly. The sandstone rock does not require gunpowder. The total quantity to be excavated is estimated at 31,000 cubic yards; all the stone which is raised is used in the construction of the wall for directing the course of the lower part of the river.

Some doubt existed in the mind of the engineer as to the security of the fastening of the iron rod piles by merely jumping them from 15 to 18 inches into the rock; they have, however, proved to be perfectly firm during heavy floods, when the whole dam has been submerged, and the velocity of the current which was rushing over it was not less than five miles per hour.

This paper was accompanied by two drawings, showing the general arrangement of the work, as well as the details of the construction of the coffre dam.

March 2.—The President in the Chair.

The following were balloted for and elected: Peter Hogg, Henry Oliver Robinson, Thomas Oldham, Edward Jones Biven, and Robert Ransome, as Associates.